

Department of the Interior. Fish and Wildlife Service

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## Biological Services Program

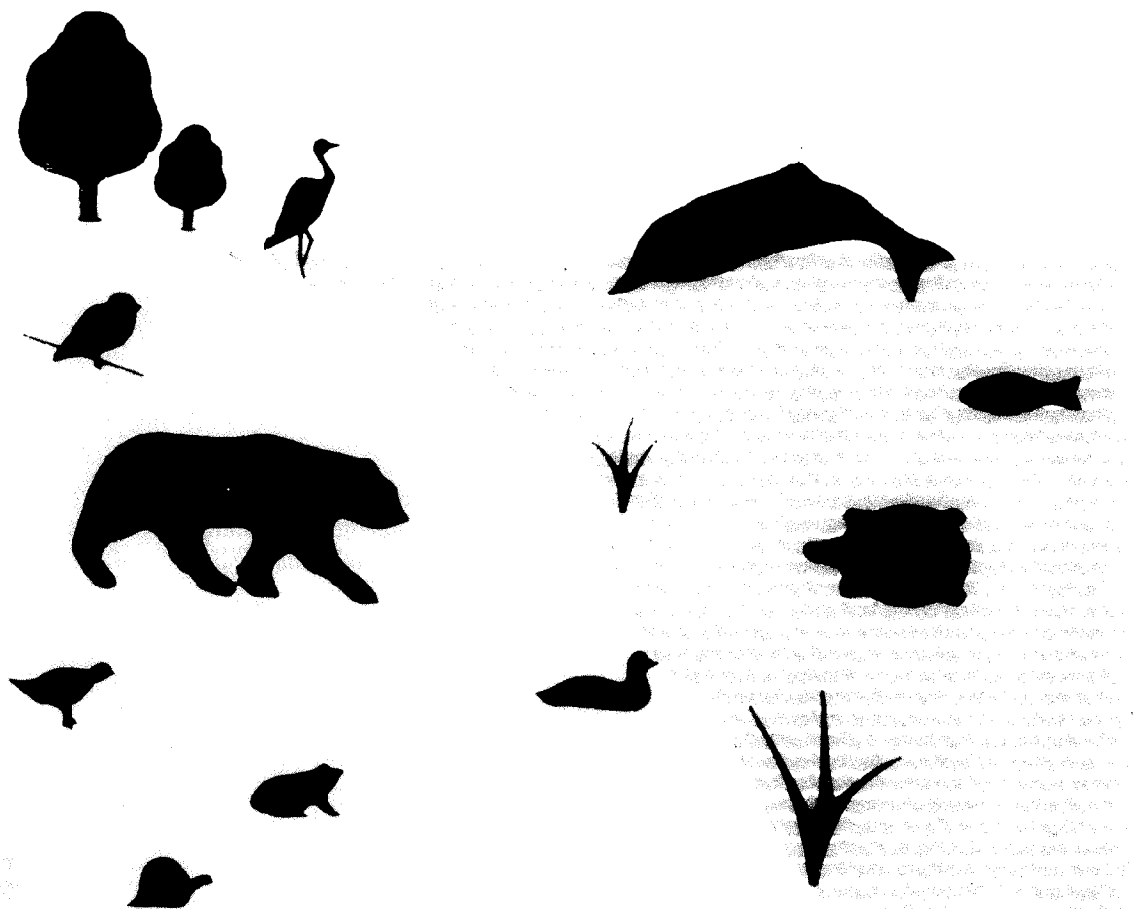
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FWS/OBS-80/51

September 1980

# Atlantic Coast Ecological Inventory

## USER'S GUIDE AND INFORMATION BASE



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Fish and Wildlife Service

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U.S. Department of the Interior

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

- To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.
- To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major changes in land and water use.
- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

Information developed by the Biological Services Program is intended for use in the planning and decisionmaking process to prevent or minimize the impact of development on fish and wildlife. Research activities and technical assistance services are based on an analysis of the issues, a determination of the decisionmakers involved and their information needs, and an evaluation of the state of the art to identify information gaps and to determine priorities. This is a strategy that will ensure that the products produced and disseminated are timely and useful.

Projects have been initiated in the following areas: coal extraction and conversion; power plants; geothermal, mineral and oil shale development; water resource analysis, including stream alterations and western water allocation; coastal ecosystems and Outer Continental Shelf development; and systems inventory, including National Wetland Inventory, habitat classification and analysis, and information transfer.

The Biological Services Program consists of the Office of Biological Services in Washington, D.C., which is responsible for overall planning and management; National Teams, which provide the Program's central scientific and technical expertise and arrange for contracting biological services studies with states, universities, consulting firms, and others; Regional Staffs, who provide a link to problems at the operating level; and staffs at certain Fish and Wildlife Service research facilities, who conduct in-house research studies.

15531

FWS/OBS-80/51  
September 1980

ATLANTIC COAST ECOLOGICAL INVENTORY  
USER'S GUIDE AND INFORMATION BASE

by

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## PREFACE

The U.S. Department of the Interior and the Fish and Wildlife Service (FWS) have played major roles in issues involving the siting of coastal refinery projects. The basis for the Department's position on these types of projects has been the National and regional significance of the fish and wildlife resources at the proposed sites and the susceptibility of these resources to new or added stress.

Given the projected needs for oil refineries and energy facilities along the Atlantic coast, as well as the future likelihood for Departmental involvement in siting issues, the Under Secretary of the Interior proposed that "... Government should take the initiative in helping industry find locations for refineries, power plants, and other energy stations which would best serve the interests of all involved" (news conference, Norfolk, Virginia, 2 January 1979). In addition, the Council on Environmental Quality has explored what Federal agencies might do to provide advance information on the environmental sensitivity of various coastal areas to the impacts of major energy facilities.

The objective is to produce an inventory of those important ecological resources along the Atlantic coast which could be impacted by coastal siting of refineries, petrochemical, and gas or liquid natural gas facilities.

Questions about, or requests for copies of this publication should be addressed to:

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The U.S. Fish and Wildlife Service would like to thank Bill Jones, Bruce Palmer, and John Roney employed by the U.S. Geological Survey for their assistance in the design and quality control in producing the maps for this study.

Numerous Federal and State agencies, and private individuals contributed valuable resource information which was key to the accomplishment of this inventory effort.

## PART 1

### INTRODUCTION

#### 1.1 BACKGROUND

Plans for new major energy facilities along the Atlantic coastline of the United States have recently conflicted with the protection of valuable coastal fish and wildlife species and their habitats. Conflicts arose during the recent proposed siting of oil refineries in Maine and Virginia. In Eastport, Maine, the conflict centered around the siting of a proposed refinery in an area where numerous bald eagles nest and other valuable resources occur. The siting of a proposed refinery on the Chesapeake Bay at Portsmouth, Virginia, was opposed primarily because the resources were already under stress. The area supports extensive oysterbeds and a blue crab overwintering area.

To reduce future conflicts, such as those which occurred in Maine and Virginia, the U.S. Fish and Wildlife Service (FWS) has conducted an ecological inventory to assist industry in their advanced planning and evaluation procedures. FWS's intent was to lessen the chance for serious dispute during the later permit review evaluation process. This study resulted in 31 fish and wildlife coastal inventory maps (referred to in this report as maps) and a User's Guide and Information Base (referred to as the report). This is the first phase of an effort by FWS to provide planners and industry officials with the appropriate assistance and guidance in their plans for environmental protection. The maps reduce the potential for conflict by depicting areas or resources that are most ecologically or economically valuable and that could be most vulnerable to the construction and operation of energy-producing facilities. In addition, the maps should be of assistance in reducing environmental damage from energy facilities at any location along the Atlantic coast.

Although the value of the inventory maps is somewhat restricted by their scale and the scarcity of fish and wildlife and habitat information, this report and the maps provide a comprehensive inventory of the natural resources of the Atlantic coast. These resource maps have been sought by coastal planners for coastal zone management and oil spill contingency planning.

## 1.2 PURPOSE AND SCOPE

The purpose of the User's Guide and Information Base report and the inventory maps is to establish the size and scope of natural resources, as well as their location and value. The report supplements the maps with biological descriptions and lends support and credence to the map inventories. The maps identify significant natural resource areas and fish and wildlife resource concentrations along the Atlantic seaboard which are vulnerable to the construction and operation of oil- and gas-processing facilities and transportation systems. The focus of this inventory is on the ecological resources subject to the provisions of the Fish and Wildlife Coordination Act, the Endangered Species Act, and other related legislation. The area covered by the inventory ranges from the Canadian border to the southern tip of Florida, excluding the Florida Keys. The study area includes the shoreline seaward to the Federal-state demarcation zone (the three-mile limit), and inland to the coastal zone boundary, as defined by each state. In special cases, the study area extends to the head of navigable waterways under tidal influence.

The maps provide an inventory of important coastal fish and wildlife species and their habitats. Other land-use designations, such as wildlife refuges, parks, and Federal Class I air quality areas, also are included. The maps and this report do not designate areas where energy facilities or transportation systems should be located, but rather they both identify areas of significant concern. These maps are not intended as the only source of resource information for the Atlantic coast. Due to the small-scale maps and schedule constraints on data collection, only significant species locations and distributions are presented.

## 1.3 COASTAL CLASSIFICATION AND DESCRIPTION

The study area (shaded coastline, figure 1) covers portions of 15 coastal states and occupies approximately 196,840 square kilometers (76,000 square miles). The study area lies within two physiographic provinces: the New England Province and the Coastal Plain Province. The New England Province occupies the northern segment of the coast from the Canadian border to Long Island Sound. The middle and southern segments of the Atlantic coast, extending from Long Island Sound southward to the southern tip of Florida, are situated within the Coastal Plain Province. Each of these provinces corresponds closely to the Level I hierarchical classification scheme for coastal ecosystems developed by Terrell (1979). The New England Province is compatible with Terrell's North Atlantic Zone and the Coastal Plain Province is contained within Terrell's Middle Atlantic, South Atlantic, and Southern Florida Zones. This report is organized according to the Level I (zones) and Level II (sections) subdivisions which comprise Terrell's classification (figure 2). A description of each section in each zone is given in table 1. The 12 sections provide the format for describing the resources identified in the inventory. For this report, Terrell's Level I boundary between the Middle Atlantic and South Atlantic Zones was moved northward from Cape Hatteras, North Carolina, to Cape Henry, Virginia, and the Southern Florida Zone is discussed as part of the South Atlantic Zone. For additional clarity, the original Level II boundary for the Sea Islands section was moved southward from Cape Fear to Winyah Bay.

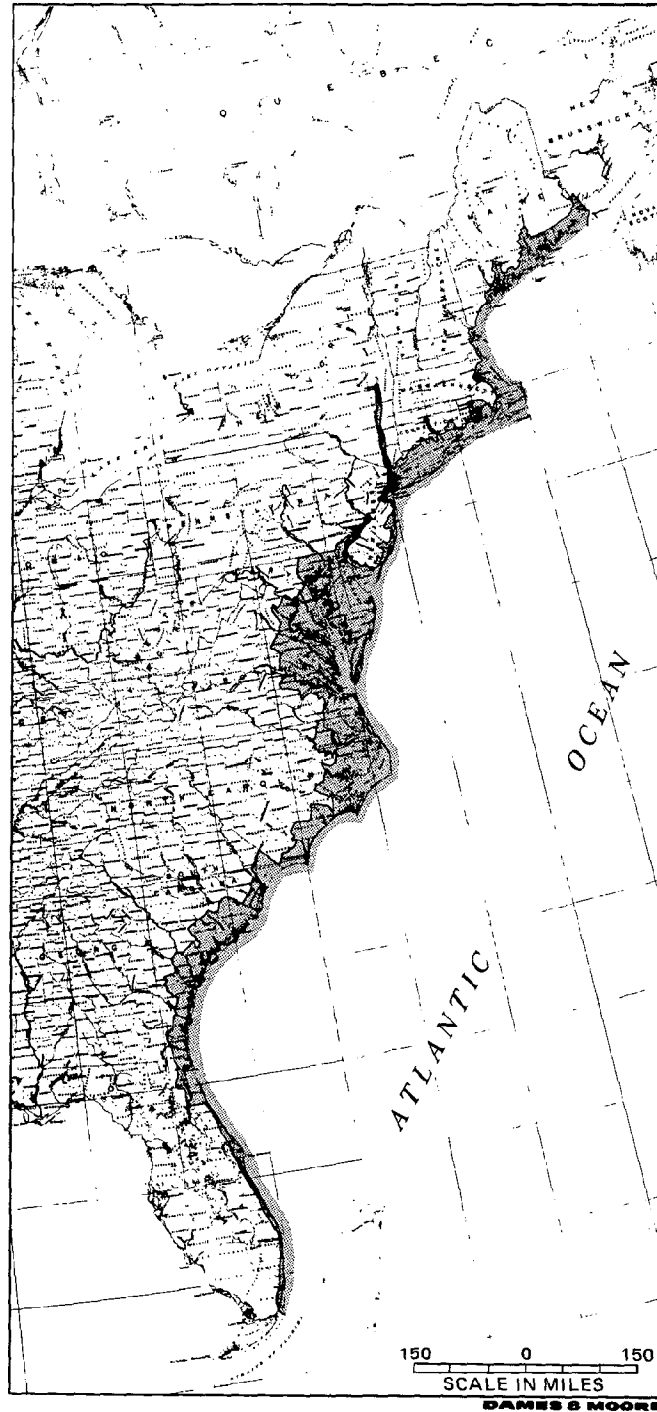


Figure 1. The study area.

Table 1. Classification scheme for Atlantic coast ecosystems (modeled after Terrell, 1979).

Level I (zones)	Level II (sections)	Boundaries	Section descriptions
North Atlantic	Gulf of Maine Coast	Maine-Canada border to Cape Elizabeth	Rocky, deeply incised (drowned) coastline with numerous bays, estuaries, and islands. High tidal range, creating abundance of intertidal pool communities. Small areas of mudflats and marshes, few shallow areas.
	Northern New England Coast	Cape Elizabeth to Cape Cod at Monomoy Island	Some rocky shores, Cape Elizabeth to Cape Ann, mainly sandy beaches south of Cape Ann. Sandy or cobble beaches with high energy except those sheltered within Cape Cod Bay.
Middle Atlantic	Southern New England Coast	Cape Cod at Monomoy Island to Montauk Point, including Long Island Sound	Fairly irregular coastline with several large islands, two large bays, and two sounds (one--Long Island Sound--very large, protected). Mainly sandy beaches, some high energy, with marsh areas behind, some barrier islands, some with dune systems.

continued

Table 1 (continued).

Level I (zones)	Level II (sections)	Boundaries	Section descriptions
Middle Atlantic (continued)	New York Bight	Montauk Point to Cape May	Coastline dominated by wide, sandy, high-energy beaches, often with dune systems on barrier islands protecting bays and extensive marshes.
	Delaware Bay	Cape May to Cape Henlopen	Large embayment somewhat protected from ocean. Extensive marshes on both sides to 80 kilometers (50 miles) up bay. Some oyster reefs in middle and lower reaches.
	Delmarva Shore	Cape Henlopen to Cape Charles	Dominated by series of barrier islands with some dune systems and high-energy, wide, sandy beaches. Extensive marsh system in protected shallow waters behind islands.
	Chesapeake Bay	Cape Charles to Cape Henry	Very large, "drowned coastline" estuary with several riverine subestuary systems. Largely protected from high-energy ocean influence but with pronounced influence by saline waters and marine organisms on declining gradient northward into bay.

continued

Table 1 (continued).

Level I (zones)	Level II (sections)	Boundaries	Section descriptions
Middle Atlantic (continued)	Chesapeake Bay	Cape Charles to Cape Henry	Extensive marsh systems, especially on Eastern Shore, some oyster reefs. Sediment transport processes, turbidity highest in upper bay.
South Atlantic	Pamlico Sound Complex	Pamlico, Albemarle, Currituck Sounds, and Back Bay	Wide, sandy beaches with extensive marshy areas, mostly characterized by very extensive outer bank and barrier island system which protects the sound complex. Reasonably high amount of freshwater inflow.
	Virginia-Carolina Coast	Seaward coast of Outer Banks from Cape Henry to Cape Lookout and both estuarine systems and seaward islands from Cape Lookout to Winyah Bay	Broad white quartz sand beaches; estuarine systems, smaller than the Pamlico Sound Complex, are protected by numerous long, narrow, small barrier islands. Also includes marine systems seaward of barrier islands from Cape Hatteras to Cape Fear.
	Sea Islands	Winyah Bay to St. Johns River	Barrier islands small and numerous, coastline less protected, fairly highly dissected coastline with high freshwater inflow, gently sloping, wide quartz sand beaches, and very extensive marshes.

continued

Table 1 (continued).

Level I (zones)	Level II (sections)	Boundaries	Section descriptions
South Atlantic (continued)	East Florida	St. Johns River to Fort Lauderdale	Low-lying beaches of calcareous sand, extensive marshy areas, some areas of very extensive barrier islands, freshwater inflow only from coastal plain.
	Biscayne Bay	Fort Lauderdale to Biscayne Bay	Extremely low-lying swampy coastline.

concluded

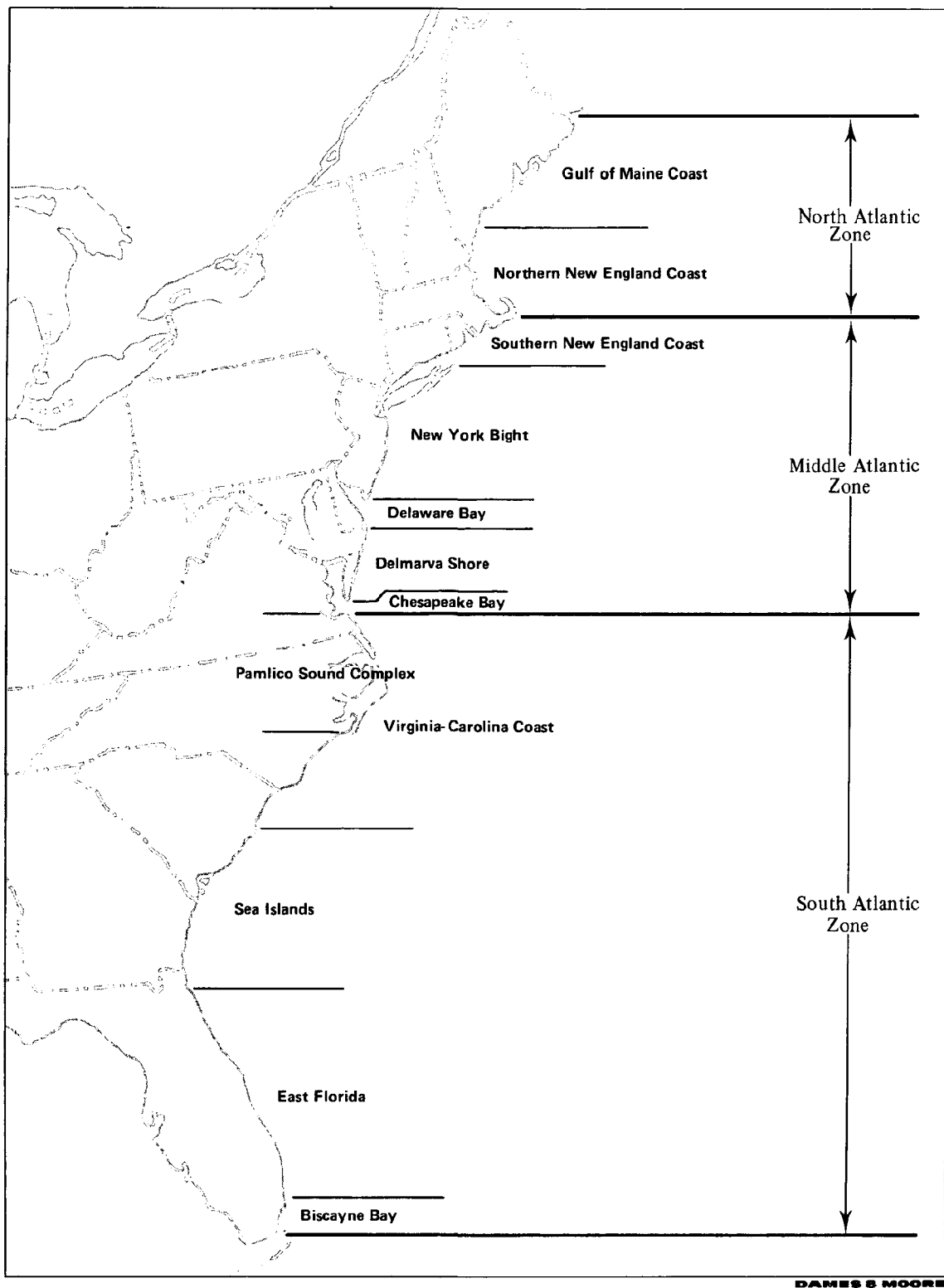


Figure 2. Classification scheme for Atlantic coast ecosystems, showing zones and sections (modeled after Terrell, 1979).

The North Atlantic Zone occupies the northern quarter of the study region (figure 2). The Gulf of Maine Coast and the Northern New England Coast sections of the North Atlantic Zone are underlain by crystalline rock and are characterized by low rolling hills of moderate relief, which have been modified by glacial action. The Maine coastline, in particular, is a typical shoreline of submergence exhibiting numerous embayments, fiord-like estuaries, and wave-cut cliffs.

The Southern New England Coast section in the Middle Atlantic Zone is characterized by dissected and glaciated low hills of moderate relief, which have developed on complex structural features of crystalline rock. Although the coastline is irregular and submerged, it does not exhibit the deeply incised bays and estuaries which are prominent in Maine and in parts of northern Massachusetts and eastern Rhode Island.

The physiography of the Atlantic coast changes markedly from Long Island Sound to Florida. This change in coastline pattern and topographic configuration is due principally to differences in lithology and processes of deposition and erosion along a shoreline which varies from submerged to composite to emergent. The coast from New York to Florida is characterized by a series of poorly consolidated, gently dipping sedimentary strata consisting of variable thicknesses of sands, silts, clays, and marls. Physiographically, this area extends from Cape Cod southward to the East Florida section.

From the New York Bight subsection, located in the Middle Atlantic Zone, south to the Pamlico Sound subsection of the South Atlantic Zone is a sub-maturely dissected, composite shoreline of low-to-moderate relief containing numerous terraces aligned parallel to the coast. The coastline is highly irregular and is characterized by drowned river valleys and wide embayments including the Delaware and Chesapeake Bays. A series of long, narrow barrier islands occurs offshore, particularly in areas adjacent to the southern coast of Long Island, and portions of New Jersey, the Delmarva Coast, and North Carolina. These barrier island systems serve to protect bays, shallow waters, and marshes from wave action and currents along the coast.

The Virginia-Carolina Coast and Sea Islands sections have a low relief, terraced coastal plain with a submerged and dissected coastline. Large rivers in this area carry sediment loads which, when deposited at the river mouth, form barrier beaches and extensive marshes backed by swamps. The barrier islands in this section are small, but numerous in comparison to the longer, more continuous stretches which characterize the lower Middle Atlantic Zone.

The East Florida section is a young marine plain of very low relief characterized by sandhills, swamps, sinks, and lakes. Few streams drain in this lowland area. The underlying sedimentary strata recently have been raised above sea level and the coastline is a typical shoreline of emergence, characterized by an extensive series of nearly continuous barrier islands extending from Daytona Beach to Biscayne Bay. Biscayne Bay is discussed as part of the South Atlantic Zone in this report.

## PART 2

### METHODOLOGY

#### 2.1 COASTAL ZONE BOUNDARIES

The study area inland boundaries are the same, with a few exceptions, as the coastal zone boundaries for each state. Information on coastal zone boundaries (to establish the study area boundaries) was obtained from maps and reports supplied by the Office of Coastal Zone Management of the National Oceanic and Atmospheric Administration (NOAA) and by each of the 15 states along the Atlantic seaboard. The three-mile limit delineation (offshore boundary) was based on information furnished by the Bureau of Land Management (BLM) and NOAA. Because the designation of inland coastal boundaries is complex, the extent of the boundaries, as defined for this study, is summarized in table 2. For the five New England states, the coastal zone boundaries encompass the inland limits of designated coastal towns, except in Connecticut where the coastal zone extends up the Connecticut River to Hartford. In New York, the coastal zone boundary includes Long Island and a portion of the Hudson River Valley to Albany. The coastal zone boundaries used in this study to define the inland limits of Massachusetts, Rhode Island, Connecticut, and New York were extended beyond the officially designated state limits so that they would be compatible with the regional 1:250,000-scale map presentation. In New Jersey and Pennsylvania, the inland boundaries were based on a series of roads and rights-of-way. Delaware's coastal zone includes the entire State. The inland coastal zone boundaries for Maryland and Virginia, follow the coastal (tidewater) counties and independent cities. In addition, Washington, D.C., is included as part of the coastal zone. Coastal county boundaries were used for defining the North Carolina, South Carolina, and Georgia inland boundaries. In Florida, roads and rights-of-way define the inland coastal boundary. For the specific location of accepted coastal zone management boundaries, contact the appropriate state coastal zone management agency.

#### 2.2 DATA COLLECTION AND REPORTING

The data used to compile the habitat inventory maps and the supporting narrative report were collected from numerous Federal organizations such as FWS, the National Marine Fisheries Service (NMFS), the U.S. Environmental Protection Agency (EPA), BLM, NOAA, water and natural resource divisions of the various states, and private organizations, such as the Atlantic States Fisheries Commission, regional planning commissions, environmental research foundations, and universities. The references acquired from the numerous

Table 2. Criteria for establishing state coastal zone management (CZM) boundaries.

State	Coastal zone boundary follows or includes	Source
Maine	Coastal towns	State CZM
New Hampshire	Coastal towns	State CZM
Massachusetts	Coastal towns	State CZM
Rhode Island	Coastal towns	State CZM
Connecticut	Coastal towns plus Connecticut River to Hartford	State CZM
New York	All of Long Island and Hudson Valley to Albany	State CZM
New Jersey	Roads and rights-of-way; Delaware and Hudson River areas determined for this study	State CZM
Pennsylvania	Roads and rights-of-way	State CZM
Delaware	Coastal counties (entire state)	State CZM
Maryland	Coastal (tidewater) counties plus Washington, D.C.	State CZM
Virginia	Coastal (tidewater) counties and towns	State CZM
North Carolina	Coastal (tidewater) counties	State CZM
South Carolina	Coastal counties	State CZM
Georgia	Coastal counties	FWS using state's former CZM boundary
Florida	Roads and rights-of-way	State CZM

agencies were reviewed and analyzed for each geographic area, and information on major habitats and fish and wildlife resource groups was abstracted. For a complete listing of all information sources contacted, see the List of Sources included at the end of each section of this report. Major emphasis was placed on information that was accurate, useful, and applicable to the inventory maps.

Because the base map scale was relatively small (1:250,000), the amount of information shown on each map was considered carefully to prevent excessive detail and confusion. Species with special status and special land-use areas were major elements of the map inventory. For example, the location of every endangered or threatened species and the special land-use areas, such as parks, wildlife refuges, and preserves, within the study boundaries were shown on the maps where data were available.

The maps present significant resources using both point feature and area feature symbols. Instead of multiple overlays, the information on a single map was indicated by using various symbols, colors, and patterns. This method was found to provide the most uncluttered, readable, and understandable map.

Major categories shown on the inventory maps were species with special status (e.g., the endangered shortnose sturgeon), valuable resources (e.g., shellfish and waterfowl), migratory routes (e.g., shorebirds and Atlantic salmon), and seasonal habits (e.g., overwintering). Additional information about distribution, density, and life history of a particular species or group was incorporated in this report for each of the coastal zones (parts 4 to 6).

## 2.3 DATA REVIEW AND ANALYSIS

The data and literature search included cataloging, reviewing, and analyzing a large amount of ecological data. This review was a major task, and deciding what data should be included on the maps required considerable judgement.

One or more writers of this report visited selected areas within each of the three major zones. They collected information and corresponded with ecologists and fish and game agency personnel. However, most of the information was obtained by telephoning Federal, state, local, and private groups familiar with the resources of a particular area and by requesting appropriate reports and data.

A list of most of the important plants and animals (and their scientific names) in the study area (364 species) is given in table 3. Data were compiled for each species which had a special status designation (endangered or threatened) and for groups (e.g., fish or birds), types of habitat (e.g., reefs or marshes), and when available, resource statistics also were compiled. The type and amount of detail shown on each map was dependent on the type and amount of information available.

Data were most available for species which were threatened and endangered, and for fish and wildlife species that support commercial or sport industries. For major fisheries, data on the maps include spawning and nursery areas, shellfish bed locations, and fishing areas. For birds, wildlife,

Table 3. Species or groups of organisms (with identifying numbers) in the Atlantic Coast Ecological Inventory.\*

AQUATIC SPECIES

PLANTS (1 through 50)

- 1 Irish moss (Chondrus crispus)
- 2 Rockweed

INVERTEBRATES (51 through 100)

- 51 Crabs
- 52 Mussels
- 53 Oysters
- 54 Scallops
- 55 Clams
- 56 Worms
- 57 Shrimp
- 58 American lobster (Homarus americanus)
- 59 Blue crab (Callinectes sapidus)
- 60 Eastern oyster (Crassostrea virginica)
- 61 European oyster (Ostrea edulis)
- 62 Bay scallop (Argopecten irradians)
- 63 Deep-sea scallop (Placopecten magellanicus)
- 64 Calico scallop (A. gibbus)
- 65 Surf clam (Spisula solidissima)
- 66 Hard clam (Mercenaria mercenaria)
- 67 Soft shell clam (Mya arenaria)
- 68 Brackish-water clam (Angaria cuneata)
- 69 Bloodworm (Glycera dibranchiata)
- 70 Sandworm (Nereis virens)
- 71 White shrimp (Penaeus setiferus)
- 72 Brown shrimp (P. aztecus)
- 73 Northern shrimp (Pandulus borealis)
- 74 Rock crab (Cancer irroratus)
- 75 Jonah crab (C. borealis)
- 76 Whelk (Busycon sp.)
- 77 Ocean quahog (Arctica islandica)
- 78 Pink shrimp (Penaeus duorarum)
- 79 Stone crab (Hemippe mercenaria)
- 80 Spiny lobster (Panulirus argus)

FISH (101 through 200)

- 101 Sharks, skates, rays (Chondrichthyes)
- 102 Herring (Clupeidae)
- 103 Salmon and trout (Salmonidae)
- 104 Catfish (Ictaluridae, Aridae)
- 105 Cod (Gadidae)
- 106 Sunfish and bass (Centrarchidae)
- 107 Drum (Sciaenidae)
- 108 Flatfish (Pleuronectiformes)
- 109 Longnose gar (Lepisosteus osseus)
- 110 Shortnose sturgeon (Acipenser brevirostrum)
- 111 Atlantic sturgeon (A. oxyrinchus)
- 112 American eel (Anguilla rostrata)
- 113 Blueback herring (Alosa aestivalis)

- 114 Hickory shad (A. mediocris)
- 115 Alewife (A. pseudoharengus)
- 116 American Shad (A. sapidissima)
- 117 Atlantic menhaden (Brevoortia tyrannus)
- 118 Atlantic herring (Clupea harengus harengus)
- 119 Gizzard shad (Dorosoma cepedianum)
- 120 Tarpon (Megalops atlantica)
- 121 Atlantic salmon (Salmo salar)
- 122 White catfish (Ictalurus catus)
- 123 Channel catfish (I. punctatus)
- 124 Yellow bullhead (I. natalis)
- 125 Brown bullhead (I. nebulosus)
- 126 Flat bullhead (I. platycephalus)
- 127 Sea catfish (Arius felis)
- 128 White perch (Morone americana)
- 129 Striped bass (M. saxatilis)
- 130 Black sea bass (Centropristis striata)
- 131 Redbreast sunfish (Lepomis auritus)
- 132 Warmouth (L. gulosus)
- 133 Bluegill (L. macrochirus)
- 134 Largemouth bass (Micropterus salmoides)
- 135 Black crappie (Pomoxis nigromaculatus)
- 136 Sheepshead (Archosargus probatocephalus)
- 137 Spotted seatrout (Cynoscion nebulosus)
- 138 Weakfish (C. regalis)
- 139 Spot (Leiostomus xanthurus)
- 140 Atlantic croaker (Micropogon undulatus)
- 141 Southern kingfish (Menticirrhus americanus)
- 142 Northern kingfish (M. saxatilis)
- 143 Gulf kingfish (M. littoralis)
- 144 Red drum (Sciaenops ocellata)
- 145 Star drum (Stellifer lanceolatus)
- 146 Black drum (Pogonias cromis)
- 147 Summer flounder (Paralichthys dentatus)
- 148 Southern flounder (P. lethostigma)
- 149 Winter flounder (Pseudopleuronectes americanus)
- 150 Rainbow smelt (Osmerus mordax)
- 151 Atlantic tomcod (Microgadus tomcod)
- 152 Threadfin shad (Dorosoma petenense)
- 153 Carp (Cyprinus carpio)
- 154 Atlantic mackerel (Scomber scombrus)
- 155 Chain pickerel (Esox niger)
- 156 White bass (Morone chrysops)
- 157 Northern puffer (Sphaeroides maculatus)
- 158 Silver perch (Bairdiella chrysura)
- 159 Florida pompano (Trachinotus carolinus)
- 160 Bluefish (Pomatomus saltatrix)
- 161 Spanish mackerel (Scomberomorus maculatus)
- 162 Cobia (Rachycentron canadum)
- 163 Mullet (Mugilidae)
- 164 White crappie (Pomoxis annularis)
- 165 Redear sunfish (Lepomis microlophus)
- 166 Smallmouth bass (Micropterus dolomieu)

REPTILES AND AMPHIBIANS (201 through 250)

- F 201 Green sea turtle (Chelonia mydas)
- F 202 Loggerhead sea turtle (Caretta caretta)
- F 203 Hawksbill turtle (Eretmochelys imbricata)
- F 204 Atlantic ridley turtle (Lepidochelys kempi)
- F 205 Leatherback turtle (Dermochelys coriacea)

MAMMALS (251 through 300)

- F 251 Florida manatee (Trichechus manatus)
- 252 Atlantic bottlenose dolphin (Tursiops truncatus)
- 253 Pigmy sperm whale (Kogia breviceps)
- 254 Short-finned pilot whale (Globicephala macrorhyncha)
- 255 Harbor seal (Phoca vitulina)
- 256 Gray seal (Halichoerus grypus)
- F 257 Right whale (Eubalaena glacialis)
- 258 Atlantic spotted dolphin (Stenella plagiodon)

Continued

Table 3 (cont. in.)

## TERRESTRIAL SPECIES

## PLANTS (301 through 350)

- 301 Eastern hemlock (*Tsuga canadensis*)  
 S 302 Spleenwort (*Asplenium heterostichum*)  
 S 303 Spider lily (*Lycophotia coronaria*)  
 S 304 Pond bush (*Litsea pestivalis*)  
 S 305 Watermillet (*Murphyella laxum*)  
 S 306 Hooded pitcher plant (*Sarracenia minor*)  
 307 Tree  
 S 308 Prickly pear cactus (*Opuntia humifusa*)  
 S 309 Trailing arbutus (*Epigaea repens*)  
 310 Eastern bumelia (*Bumelia lycioides*)  
 311 Pitcher plant (*Sarracenia purpurea*)  
 312 Baldcypress (*Taxodium distichum*)  
 313 Redbay (*Persea borbontia*)  
 314 Seaside alder (*Alnus maritima*)  
 315 Box huckleberry (*Laylussacia brachycera*)  
 316 Purple fringed orchid (*Habenaria peramoena*)  
 317 Pink lady's slipper (*Cypripedium acaule*)  
 S 318 Ebony solewort (*Asplenium platyneuron*)  
 S 319 Orchids (*Orchidaceae*)  
 S 320 Golden club (*Orontium aquaticum*)  
 321 Florida beargrass (*Nolina atopocarpa*)  
 322 East-coast coontie (*Zamia umbrosa*)  
 323 Fall-flowering ixia (*Nemastylis floridana*)  
 324 Jackson-vine (*Smilax smallii*)  
 325 Spoon-flower (*Peltandra sagittifolia*)  
 326 Curtiss milkweed (*Asclepias curtissii*)  
 327 Sea lavender (*Mallotonia graphalodes*)  
 328 Hand fern (*Ophioglossum palmatum*)  
 329 Needle palm (*Rhaphidophyllum hystrix*)  
 330 Yellow squirrel-banana (*Derringerthamnus rugellii*)  
 331 Beach creeper (*Ernodea littoralis*)  
 332 Florida coontie (*Zamia floridana*)  
 333 Four-petal pawpaw (*Asimina tetramera*)  
 334 Bird's nest spleenwort (*Asplenium serratum*)  
 335 Burrowing four-o'clock (*Okenia hypogaea*)  
 336 Beach star (*Remirea maritima*)  
 337 Silver palm (*Coccothrinax argentea*)  
 338 Dancing lady orchid (*Oncidium variegatum*)  
 339 Tamarindillo (*Acacia chorophylla*)  
 340 Fuch's bromeliad (*Guzmania monostachia*)  
 341 Everglades peperomia (*Peperomia floridana*)  
 342 Buccaneer palm (*Pseudophoenix sargentii*)  
 343 Slender spleenwort (*Asplenium dentatum*)  
 344 Pineland Jacquemontia (*Jacquemontia curtissii*)  
 345 Mahogany mistletoe (*Phoradendron rubrum*)  
 346 Florida thatch (*Thrinax floridana*)  
 347 Twisted air plant (*Tillandsia flexuosa*)  
 348 Long's bittercress (*Cardamine longii*)  
 349 Venus flytrap (*Dionaea muscipula*)

## INVERTEBRATES (351 through 400)

- 351 Monarch butterfly (*Danaus plexippus*)  
 352 Zebra butterfly (*Papilio marcellus*)  
 BIRDS (401 through 600)  
 Shorebirds (401 through 430)  
 401 Terns  
 402 Gulls  
 403 Forster's tern (*Sterna forsteri*)  
 404 Arctic tern (*S. paradisaea*)  
 405 Least tern (*S. albigularis*)  
 406 Roseate tern (*S. dougalii*)  
 407 Common tern (*S. hirundo*)  
 408 Great black-backed gull (*Larus marinus*)  
 409 Herring gull (*L. argentatus*)  
 410 Laughing gull (*L. atricilla*)  
 411 Black skimmer (*Rynchops nigra*)  
 412 Turnstones (*Arenariae*)  
 413 Plovers (*Charadriidae*)  
 414 Piping plover (*Charadrius melodus*)  
 415 American oystercatcher (*Haematopus palliatus*)  
 S 416 Waxing birds (431 through 460)  
 431 Herons (*Ardeidae*)  
 432 Egrets (*Ardeidae*)  
 433 Rails (*Rallidae*)  
 434 Ibises (*Threskiornithinae*)  
 435 Bitterns (*Botaurinae*)  
 S 437 Great blue heron (*Ardea herodias*)  
 S 438 Wood ibis (*Mycteria americana*)  
 439 Anhinga (*Anhinga anhinga*)  
 S 440 Little blue heron (*Florida caerulescens*)  
 S 441 Yellow-crowned night heron  
 442 Black-crowned night heron  
 S 443 Florida sandhill crane (*Grus canadensis pratensis*)  
 S 444 Louisiana heron (*Hydranassa tricolor*)  
 S 445 Limpkin (*Aramus guarana*)  
 S 446 Roseate spoonbill (*Ajaja ajaja*)  
 S 447 Snowy egret (*Leucophaea thula*)  
 S 448 Magnificent frigatebird (*Fregata magnificens rothschildi*)  
 S 449 Reddish egret (*Dichromanassa rufescens*)  
 450 Clapper rail (*Rallus longirostris*)  
 451 King rail (*Rallus elegans*)  
 452 Virginia rail (*Rallus limicola*)  
 453 Sora rail (*Porzana carolina*)  
 461 Waterfowl (461 through 500)  
 462 Swans (*Cygninae*)

Continued

- Geese (*Anserinae*)  
 463 Dabbling ducks (*Anatinae*)  
 464 Diving ducks (*Aythiinae*)  
 465 Common eider (*Somateria mollissima*)  
 466 Harlequin duck (*Histrionotus histrionicus*)  
 467 Wood duck (*Aix sponsa*)  
 468 Fulvous tree duck (*Dendrocygna bicolor*)  
 470 Loons (*Gaviidae*)  
 471 Grebes (*Podicipedidae*)  
 472 Brant geese (*Branta bernicla*)  
 473 Snow goose (*Chen hyperborea*)  
 474 Gadwall (*Anas strepera*)  
 475 Black duck (*Anas rubripes*)  
 501 Raptors (501 through 530)  
 502 Owls (*Strigiformes*)  
 503 Kites (*Elaninae*, *Milvinae*)  
 504 Hawks (*Accipitrinae*, *Buteoninae*)  
 F 505 Bald eagle (*Haliaeetus leucocephalus*)  
 S 506 Osprey (*Pandion haliaetus*)  
 F 507 Peregrine falcon (*Falco peregrinus*)  
 S 508 Cooper's hawk (*Accipiter cooperii*)  
 509 Swallow-tailed kite (*Elaoides forficatus*)  
 S 510 Marsh hawk (*Circus cyaneus*)  
 S 511 Southeastern American kestrel (*Falco sparverius paulus*)  
 S 512 Florida burrowing owl (*Athene cunicularia*)  
 531 Seabirds (531 through 550)  
 532 Petrels, shearwaters, and albatrosses  
 533 Pelican and allies (*Pelecaniformes*)  
 534 Alcids (*Alcidae*)  
 F 535 Brown pelican (*Pelecanus occidentalis*)  
 536 Black guillemot (*Cephus grylle*)  
 537 Leach's petrel (*Oceanodroma leucorhoa*)  
 538 Razorbill (*Alca torda*)  
 539 Common puffin (*Fratercula artica*)  
 540 Double-crested cormorant (*Phalacrocorax auritus*)  
 541 Gannet (*Morus bassanus*)  
 542 Wilson's petrel (*Oceanites oceanicus*)  
 543 Northern phalarope (*Lobipes lobatus*)  
 544 Audubon's shearwater (*Puffinus thermophilus*)  
 545 Greater shearwater (*P. gravis*)  
 546 Shearwaters (*Puffinidae*)  
 547 Petrels (*Hydrobatidae*)  
 548 Jaegers (*Stercorariidae*)  
 549 White pelican (*Pelecanus erythrorhynchos*)  
 551 Songbirds and others (551 through 600)  
 F 552 Red-cockaded woodpecker (*Dendrocopos borealis*)  
 553 Chachalaca (*Ortalis vetula*)  
 F 554 Bachman's warbler (*Vermivora bachmanii*)  
 555 Wild turkey (*Meleagris gallopavo*)

Table 3 (continued).

556	American woodcock ( <u>Philohela minor</u> )	703	European fallow deer ( <u>Dama dama</u> )
557	Pileated woodpecker ( <u>Dryocopus pileatus</u> )	704	Blackbeard Island deer ( <u>O. v. nigribarbis</u> )
558	Swainson's warbler ( <u>Limothlypis swainsonii</u> )	705	Opossum ( <u>Didelphis marsupialis</u> )
559	Ruffed grouse ( <u>Bonasa umbellus</u> )	706	Marsh rabbit ( <u>Sylvilagus palustris</u> )
560	Bobwhite ( <u>Colinus virginianus</u> )	707	Rice rat ( <u>Oryzomys palustris</u> )
561	Mourning dove ( <u>Zenaidura macroura</u> )	708	Raccoon ( <u>Procyon lotor</u> )
562	Warblers ( <u>Parulidae</u> )	709	St. Simon Island raccoon ( <u>P. l. litoreus</u> )
563	Ring-necked pheasant ( <u>Phasianus colchicus</u> )	710	Mink ( <u>Mustela vison</u> )
564	Bank swallow ( <u>Riparia riparia</u> )	711	River otter ( <u>Lutra canadensis</u> )
565	Dusky seaside sparrow ( <u>Ammodramus nigrescens</u> )	712	Feral hog ( <u>Sus scrofa</u> )
566	White-crowned pigeon ( <u>Columba leucocephala</u> )	713	Feral cow ( <u>Bos taurus</u> )
	REPTILES AND AMPHIBIANS (601 through 700)	714	Cumberland Island pocket gopher ( <u>Geomys cumberlandius</u> )
601	Eastern narrow-mouthed toad ( <u>Gastrophryne carolinensis</u> )	715	Anastasia Island cotton mouse ( <u>Peromyscus gossypinus</u> )
602	Eastern indigo snake ( <u>Drymarchon corais</u> )	716	Aquatic furbearers
603	American alligator ( <u>Alligator mississippiensis</u> )	717	Black bear ( <u>Ursus americanus</u> )
604	Northern diamondback terrapin ( <u>Malaclemys terrapin</u> )	718	Bobcat ( <u>Lynx rufus</u> )
605	Amphibians	719	Eastern gray squirrel ( <u>Sciurus carolinensis</u> )
606	Greater siren ( <u>Siren lacertina</u> )	720	Eastern fox squirrel ( <u>Sciurus niger</u> )
607	Bog turtle ( <u>Clemmys muhlenbergi</u> )	721	Eastern cottontail ( <u>Sylvilagus floridanus</u> )
608	Gopher tortoise ( <u>Gopherus polyphemus</u> )	722	Delmarva fox squirrel ( <u>Sciurus niger cinereus</u> )
609	Eastern tiger salamander ( <u>Ambystoma tigrinum tigrinum</u> )	723	Muskrat ( <u>Ondatra zibethica</u> )
610	Northern fence lizard ( <u>Sceloporus undulatus hyacinthinus</u> )	724	Red fox ( <u>Vulpes fulva</u> )
611	Five-lined skink ( <u>Eumeces fasciatus</u> )	725	Bats ( <u>Chiroptera</u> )
612	Map turtle ( <u>Graptemys geographica</u> )	726	Gray fox ( <u>Urocyon cinereoargenteus</u> )
613	Plymouth red-bellied turtle ( <u>Chrysemys pseudemys rubriventris bangsi</u> )	727	Striped skunk ( <u>Mephitis mephitis</u> )
614	Eastern diamondback rattlesnake ( <u>Crotalus adamanteus</u> )	728	Nutria ( <u>Myocastor coypus</u> )
615	Carolina gopher frog ( <u>Rana areolata capito</u> )	729	Longtail weasel ( <u>Mustela frenata</u> )
616	Florida gopher frog ( <u>Rana areolata aesopus</u> )	730	Colonial pocket gopher ( <u>Geomys colonus</u> )
617	Atlantic salt marsh watersnake ( <u>Nerodia fasciata taenata</u> )	731	Wild ponies ( <u>Equus caballus</u> )
618	American crocodile ( <u>Crocodylus acutus</u> )	732	Sika deer ( <u>Cervus nippon</u> )
619	Florida Keys mole skink ( <u>Eumeces egregius egregius</u> )	733	Beach meadow vole ( <u>Microtus breweri</u> )
620	Florida black-headed snake ( <u>Tantilla oolitica</u> )	734	Block Island meadow vole ( <u>M. pennsylvanicus proreus</u> )
621	Pine barrens tree frog ( <u>Hyla andersoni</u> )	735	Pallid beach mouse ( <u>Peromyscus polionotus decoloratus</u> )
622	Northern pine snake ( <u>Pituophis melanoleucus melanoleucus</u> )	736	Sherman's fox squirrel ( <u>Sciurus niger shermani</u> )
623	Corn snake ( <u>Elaphe guttata</u> )	737	Florida mouse ( <u>Peromyscus floridanus</u> )
624	Timber rattlesnake ( <u>Crotalus horridus horridus</u> )	738	Florida panther ( <u>Felis concolor coryi</u> )
625	Southern gray tree frog ( <u>Hyla chrysocellis</u> )	739	Goff's pocket gopher ( <u>Geomys pinetis goffi</u> )
	MAMMALS (701 through 800)	740	Key Largo wood rat ( <u>Neotoma floridana smolli</u> )
701	Beaver ( <u>Castor canadensis</u> )	741	Lower keys cotton rat ( <u>Sigmodon hispidus exspatus</u> )
702	Whitetail deer ( <u>Odocoileus virginianus</u> )	742	Key Largo cotton mouse ( <u>Peromyscus gossypinus allapaticola</u> )

\* F = Federally listed threatened or endangered species.  
S = State-listed threatened or endangered species.

continued

and marine mammal species of major importance, the nesting, wintering, migratory, and major concentration areas were indicated on the maps if data were available. Because many groups or species occur ubiquitously, the notebbox on each map indicates their occurrence in each area. Areas of special biological concern, such as reefs, seagrass beds, beaches, dunes, offshore islands, marshes, and Class I shellfish waters, are indicated on the maps, depending on their size and their economic, ecological, or scientific importance. The species, habitat, and status designations have been depicted by a combination of symbols keyed to alphanumeric descriptors and color. A list of the depicted aquatic and terrestrial species and their identifying numbers is shown on each map.

The data are only as reliable as the source material. Certain information was not included on the maps if reports were not readily available, if the reports contained proprietary information, if the data were ambiguous, or if the source material was difficult to obtain. Because of time constraints, a comprehensive review of published and unpublished reports was not possible. Nonetheless, the information presented on the inventory maps and in this report represents the most reliable information available as of April 1980 for the entire Atlantic Coastal Zone.

## 2.4 INVENTORY GRAPHICS

### 2.4.1 The Maps and Grid System

The base maps used in this study are the United States Geological Survey (USGS) National Topographic Map series with a scale of 1:250,000. These maps contain the Universal Transverse Mercator (UTM) grid system. The 31 Atlantic Coast Ecological Inventory maps are shown in figure 3 and listed in table 4. Parts of two additional USGS maps have been included as insets. The extreme northern coast of Maine is covered by a portion of the Fredericton sheet which is included as an inset on the Eastport sheet. In addition, a portion of the western third of the Albany map, covering the Hudson Valley, has been placed to the left of the Hartford sheet.

The 10,000-meter centered UTM grid system is used on the maps as an aid in locating specific points. The flexibility of the UTM grid system is advantageous in this inventory because of the variable orientation of the coastline. Although major sections of the Atlantic coast trend in a north-south direction, other sections are oriented in an east-west direction. As a result, the east-west grid lines are employed to great advantage in describing the biological resources along a north-south coastal segment, whereas the north-south grid lines are used to describe the biological resources occurring within portions of an east-west coastal trend.

In this study, the UTM grid reference system has been used with the sectional classification of the Atlantic coast (table 1, figures 2 and 3). The east-west grid lines are used to provide the basic reference system for the major portion of the coast, particularly in the region extending from the southern half of the New York Bight section (New Jersey Shore) to the Biscayne Bay. The north-south grid is employed to locate the biological resources within selected portions of the study region, specifically the Gulf of Maine Coast, the Southern New England Coast, and the northern third of the New York Bight (Long Island South Shore).



Table 4. USGS maps (1:250,000) used in the Atlantic Coast Ecological Inventory and corresponding Terrell Zones and Sections.

	State	North Atlantic Zone			Middle Atlantic Zone				South Atlantic Zone				
		Gulf of Maine Coast	Northern England Coast	Southern England Coast	New York Bight	Delaware Bay	Delmarva Shore	Chesapeake Bay	Virginia- Carolina Coast	Pamlico Sound Complex	Sea Islands	East Florida	Biscayne Bay
Frederickton	ME	X											
Eastport	ME	X											
Bangor	ME	X											
Bath	ME	X											
Portland	ME; NH	X	X										
Boston	MA; NH; CT;												
	RI; ME		X										
Providence	RI; MA; CT; NY			X									
Hartford	CT; NY; NJ; MA		X	X									
Albany	NY; CT; MA;												
	NH; VT				X								
New York	NY; NJ; CT			X									
Newark	NJ; PA; NY				X								
Wilmington	DE; NJ; PA; MD				X			X					
Salisbury	MD; DE; NJ; VA				X		X	X					
Baltimore	MD; PA; VA; WV				X			X					
Washington	DC; MD; VA							X					
Richmond	VA; MD							X					
Norfolk	VA; MD							X					
Eastville	VA; NC; MD						X	X					
Manteo	NC								X				
Rocky Mount	NC								X				
Beaufort	NC								X				

continued

Table 4 (continued).

States	North Atlantic Zone			Middle Atlantic Zone			South Atlantic Zone					
	Gulf of Maine Coast	Northern New England Coast	Southern New England Coast	New York Bight	Delaware Bay	Delmarva Shore	Chesapeake Bay	Virginia- Carolina Coast	Pamlico Sound Complex	Sea Islands	East Florida	Biscayne Bay
Florence								X		X		
Georgetown								X		X		
James Island										X		
Augusta										X		
Savannah										X		
Brunswick										X		
Jacksonville										X	X	
Daytona										X		
Beach											X	
Orlando											X	
Fort Pierce											X	
West Palm											X	
Beach											X	
Miami											X	X

concluded

Instructions on how to use the UTM system are found in the User's Guide (part 3) of this report and on the legend of each map. Standard alphanumeric coding is employed to identify the geographic location of specific points.

#### 2.4.2 Cartographic Discussion

USGS supplied the separation plates for each of the base map sheets used in this study. Each map sheet generally consists of a series of separation plates that show drainage, open water, contour, road, and cultural features. The individual separation plates composing each base map were aligned and pin registered before being used for the inventory graphics. A black and white composite of each base map was reproduced on stable base mylar. These individual prepunched mylar maps then were used as the data base during the synthesis and compilation of the biological and land-use resources of the study region. Special land-use delineations were compiled directly on the mylar base. The terrestrial and aquatic resources were compiled on separate mylar overlays and pin registered to each of the mylar base maps.

The cartographic effort involved a series of coordinated tasks leading to the production of 31 color-coded maps showing the ecological resources of the Atlantic coast. The tasks included negative engraving (scribing process), preparation of negative open windows (peelcoat process), composition of type nomenclature, placement of type, and photo laboratory processing.

All linework and map unit boundaries were prepared by scribing to ensure consistent line weights and close tolerance. The resulting scribe plates subsequently were used to make press-ready negatives for printing by means of contact photographic methods. In addition, the scribe plates provided the capability for applying special colors to specific map unit boundaries. For example, this process made it possible to separate and portray aquatic map unit boundaries in blue, terrestrial map unit boundaries in brown, and species with special status map unit boundaries in red. The peelcoat process allowed large areas to be portrayed with special tints. For example, yellow highlights the study area limits, and light green shows the extent of special land-use areas.

Each map sheet contains an average of 14 separate pin-registered flats--a single flat represents a specific set of similar items, such as base map information, symbols, patterns, linework, and nomenclature. Flats with the same color code were combined and photographed individually to produce a final press-ready negative. A total of five press-ready negatives were produced for each map sheet; each negative represents one of the five colors depicted on the map. The press-ready negatives were subsequently placed into a frame collar, which was developed by USGS, prior to printing.

#### 2.4.3 Inventory Map Development

The inventory maps are the major data source for the location of important biological and ecological resources along the Atlantic coast. Prior to preparing the final set of inventory maps, selected experiments were performed to evaluate and demonstrate the applicability of employing colors, patterns, and symbols for mapping different types of biological and land-use information. These experiments were directed toward determining which techniques

would be most appropriate for satisfying the resource mapping requirements of the inventory.

The two areas along the Atlantic coast selected for trial graphics were the Gulf of Maine and the Sea Islands of Georgia. The 1:250,000-scale quadrangles covering Bangor, Maine, and Brunswick, Georgia, were used. Sample color-coded maps were submitted to FWS for review and comments.

The final inventory graphics were prepared after draft copies of the inventory graphics were reviewed by the individual states. The respective comments on the accuracy and reliability of the mapped resource data were evaluated and screened prior to incorporating the suggestions onto the appropriate draft compilation manuscript. The individual map sheets were then revised and format registered prior to the preparation of press-ready negatives.

PART 3  
USER'S GUIDE

### 3.1 THE INVENTORY MAPS

The purpose of the inventory maps is to provide basic information on the biological and land-use resources of the Atlantic coast. The maps are intended to assist the user in the initial planning of energy facilities by showing the location and occurrence of important fish and wildlife species and highlighting the location of special land-use areas in the Atlantic Coastal Zone.

The inventory maps have been designed so that they can be used either independently or in association with this report. However, for best results, the user should consult the narrative report during his or her review of the inventory maps.

The frame portion of each map contains a comprehensive legend and supplemental information, showing symbols, colors, patterns and lines, and alphanumeric descriptors, each representing a specific biological resource, habitat, or special land-use feature. The base map information from the standard 1:250,000-scale National Topographic Map Series also has been retained for this inventory. Table 5 summarizes the types of cultural and ecological information shown on the inventory maps.

### 3.2 HOW TO USE THE INVENTORY MAPS

The inventory maps are multipurpose in scope and cover many aspects of the biological environment of the Atlantic Coastal Zone. The reader should pay attention to the legend and explanatory text while using the inventory maps.

For ease of identification, the inland and seaward boundaries of the coastal zone are framed by a wide hatched line pattern, the inland or land portions of the coastal zone are printed in yellow, and the seaward or water portions of the coastal zone are printed in light blue. These boundaries compose the limits of the study area, as defined by the Atlantic Coast Ecological Inventory.

The ecological information shown on the inventory maps may be divided into three general categories (see table 5): land use/land cover, aquatic organisms, and terrestrial organisms.

#### 3.2.1 Land Use/Land Cover

Special land-use areas, such as national wildlife refuges, national parks, state parks, and state wildlife management areas, always are shown with a light green tint. Depending upon its size, a special land-use area can appear as either a small circle centered over the area's location or as the official boundary of the area. A special land-use area always is identified on the

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Table 5. Summary of information shown on Atlantic Coast Ecological Inventory maps.

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Base Map

- Water features (oceans, lakes, rivers, canals)
- Cultural features (roads, railroads, airfields, civil boundaries)
- Cartographic information (map sheet name, scale, location diagram, UTM grid system)

Land Use/Land Cover

- Study area (coastal zone boundary to three-mile limit)
- Special land-use areas (refuges, wildlife management areas, national or state parks, etc.)
- Swamps
- Marshes
- Beaches and dunes
- Reefs

Aquatic Organisms

- Estuarine and riverine areas, indicated by lines depicting high-, mid-, and low-salinity, and freshwater habitats
- Point and area boundaries showing location and concentrations of aquatic organisms, including species that are threatened or endangered
- Symbol, number, and letter designators identifying general class, species or group, and habitat use for aquatic organisms
- Comprehensive species list keyed to five general classes of aquatic organisms (plants, invertebrates, fish, reptiles and amphibians, and mammals)

Terrestrial Organisms

- Point and area boundaries showing locations and concentrations of terrestrial organisms, including species that are threatened or endangered

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continued

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Table 5 (continued).

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Terrestrial Organisms (cont'd)

- Symbol, number, and letter designators identifying general class, species or group, and habitat use for terrestrial organisms
- Comprehensive species list keyed to five general classes of terrestrial organisms (plants, invertebrates, birds, reptiles and amphibians, and mammals), including six subclasses of birds (shorebirds, wading birds, waterfowl, raptors, seabirds, and songbirds and others)

Notebox

- Special explanatory text, appearing in the map area or frame border, which supplements the biological and land-use information shown on the corresponding inventory map.

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concluded

inventory maps by its official name, for example, Petit Manan National Wildlife Refuge in Maine, Jones Beach State Park in New-York, and Ragged Island Wildlife Management Area in Virginia.

Land cover features appearing on the inventory maps are swamps, marshes, beaches/dunes, seagrass beds, and reefs. Swamps and marshes are identified by screen patterns and overprinted with light blue. Beaches/dunes, seagrass beds, and reefs are depicted by individual patterns overprinted in gray.

### 3.2.2 Aquatic Organisms

Aquatic organisms are identified on the inventory maps by a variety of line widths, symbols, numbers, and letter designators. Aquatic organisms, including plants, invertebrates, fish, reptiles and amphibians, and mammals, usually are shown in blue unless the particular species has special status. Species with special status, that is, those species which are endangered or threatened, always are shown in red on the inventory maps.

Local concentrations of aquatic organisms are identified by a point feature (a solid dot of appropriate color); larger areas of concentration are delineated by an enclosed boundary; and estuarine and riverine habitats are differentiated by line symbols of varying widths. These line symbols can be solid, dashed, or dotted, depending upon the salinity range in an area. For example, a heavy solid line shown in an estuary signifies a high-salinity habitat; sequential dashed, narrow solid, and dotted lines indicate progressively lower salinity habitats. Point features, the boundary lines enclosing area features, and estuarine and riverine habitat line symbols are shown in blue, unless the particular species has special status, in which case the point or boundary line features always are highlighted in red.

The classification scheme used on the inventory maps to identify a specific aquatic species and its corresponding habitat use consists of a generalized pictorial symbol, a number, and one or more lowercase letters. The pictorial symbol denotes one of five general aquatic classes; the number refers to the individual species or group from the species list, which appears in the right-hand frame margin of each inventory map; and the lowercase letters (a through i) refer to the specific habitat use of the particular species.

A representative example, showing the manner in which this classification scheme is used on the map to identify a specific aquatic species and its habitat use designation, is shown below.

Shown	└─ Fish
in	└─ Species: Striped bass
Blue	● 129abdg
	└─ Habitat use: spawning ground, nursery, adult concentra-
	tion, migratory area

### 3.2.3 Terrestrial Organisms













Terrestrial symbols are identified on the inventory maps by a variety of symbols, numbers, and letter designators. Terrestrial organisms, including plants, invertebrates, birds, reptiles and amphibians, and mammals, usually are

shown in brown unless the particular species has special status. Species with special status, that is, species which are endangered or threatened, are always shown in red on the inventory maps.

Local concentrations of terrestrial organisms are identified by a point feature (a solid dot of appropriate color); larger areas of concentration are delineated by an enclosed boundary. Point features and boundary lines enclosing area features are shown in brown, unless the particular species has special status, in which case the point or boundary line features always are highlighted in red.

The classification scheme used on the inventory maps to identify a specific terrestrial species and its corresponding habitat use consists of a generalized pictorial symbol, a number, and one or more lowercase letters. The pictorial symbol denotes one of four general terrestrial classes or six bird subclasses; the number refers to the individual species or group from the species list, which appears in the right-hand frame margin of each inventory map; and the lowercase letters (a through i) refer to the specific habitat use of the particular species.

Representative examples, showing the manner in which this classification scheme is used on the maps to identify a specific terrestrial species and its habitat, are shown below.

Always shown in red	 Raptors  Species: bald eagle  505h  Habitat use: nesting area
	 Waterfowl  Species: diving ducks  465de  Habitat use: adult concentration, overwintering area
Shown in brown	 Mammals  Species: whitetail deer  702f  Habitat use: sport hunting area

### 3.3 HOW TO USE THE GRID REFERENCE SYSTEM

Each inventory map contains the standard UTM grid system made up of a network of 10,000-meter vertical and horizontal grid lines keyed to corresponding grid reference numbers. The legend block in the frame portion of each map identifies the map's grid zone designation, the 100,000-meter square identification for each map area, and a set of general instructions on how to use the UTM grid reference system.

In this inventory, the UTM grid reference system is used to identify the geographic location of biological resources. Specifically, the 10,000-meter grid lines, consisting of a series of alphanumeric reference points, provide the basic location system for describing the biological resources within discrete intervals, or swaths along the Atlantic coast. The east-west or horizontal grid

lines are used to subdivide sections of the Atlantic coast which trend in a north-south direction. Two horizontal grid lines define a swath generally perpendicular to the coast. The swath locates geographically the biological resources to be described. In a similar way, the north-south or vertical grid lines are used to define swaths across sections of coast which trend in an east-west direction.

The UTM grid reference system has been used with Terrell's Level II regional classification scheme for Atlantic coast ecosystems (table 1 and figure 2). The east-west grid lines are used to provide the basic reference system for describing the biological resources for the major portion of the coast, extending from the southern two-thirds of the New York Bight section south through the South Atlantic Zone. The north-south grid is used to describe the biological resources within the Gulf of Maine Coast (North Atlantic Zone) and portions of the Middle Atlantic Zone, namely, the Southern New England Coast, and the northern third of the New York Bight (South Shore of Long Island).

UTM grid locations are identified by their alphanumeric designators, consisting of two letters followed by two numbers (for example, grid reference XA02 or VT99). The two letters of the grid reference designator identify the appropriate 100,000-meter square in which the biological resource occurs; the two numbers refine the location of the feature to the nearest 10,000-meter square. The first number identifies the north-south or vertical grid line; the second number designates the intersecting east-west or horizontal grid line. The vertical grid line always is located to the left, or west, of the feature being described; the intersecting horizontal grid line always is located below, or south, of the feature of interest.

Two representative examples on how to use the UTM grid reference system are presented below.

#### Example 1

Map: Providence, RI; MA; CT; NY  
Species of interest: Plymouth red-bellied turtle  
Identify appropriate 100,000-meter square (legend block): CS  
Locate 10,000-meter vertical grid number (always to left of point): 6  
Locate 10,000-meter horizontal grid number (always below point): 3

The location is identified in the report as grid reference CS63.

#### Example 2

Map: Washington, DC; MD; VA  
The location is identified in report as: grid reference UT05  
Consult UTM legend block to identify appropriate 100,000-meter square: UT  
Locate 10,000-meter vertical grid number (always to left of point): 0  
Locate 10,000-meter horizontal grid number (always below point): 5

The grid reference refers to the location of the largest blue heron rookery in the Middle Atlantic Zone.

## PART 4

### NORTH ATLANTIC ZONE

#### 4.1 INTRODUCTION

For best results, much of the preparatory information in parts 1, 2, and 3 should be read before using the maps or using the information in part 4. Part 4 presents some of the physiographic, land-use, and geographic features of the North Atlantic Zone and the characteristics and habits of some of the major biological resources.

##### 4.1.1 Physical Description

The North Atlantic Zone (figure 4) constitutes approximately 20 percent of the study area and extends from the Canadian border to Monomoy Island off Cape Cod, Massachusetts (grid reference FW30 to DR19). This zone is affected by the Labrador Current and contains two distinct subdivisions or sections: the Gulf of Maine Coast and the Northern New England Coast.

The ecological inventory of the North Atlantic Zone is covered by portions of the following USGS 1:250,000-scale maps:

- Eastport, ME, US; NS, NB, CAN (includes portion of Fredericton, NB, CAN; ME, US)
- Bangor, ME
- Bath, ME
- Portland, ME; NH
- Boston, MA; NH; CT; RI; ME
- Providence, RI; MA; CT; NY.

The Gulf of Maine Coast lies north of Cape Elizabeth and is characterized by a rocky, fiord-like coastline with many bays, estuaries, and offshore islands. This section has some of the highest tidal ranges--up to 7 meters (23 feet)--in the United States. Consequently, the coastline has an abundance of intertidal pools with wide environmental extremes. This section of the coast has small areas of shallow mudflats and marshes. The Northern New England Coast is a succession of high-energy gravel or coarse sand beaches and rocky shores which stretch as far as Cape Ann. From Cape Ann to Cape Cod the beaches are mostly fine sands. The coastline in this section is more regular than the Gulf of Maine Coast in that it lacks the fiord-like appearance and offshore islands. Marshes in this section of the coast are more extensive than marshes to the north, but they are smaller than marshes of the Middle Atlantic Zone. The tidal range decreases from north to south throughout the zone, varying from about 6.1 meters (20 feet) in upper Passamaquoddy Bay, 3.7 meters (12 feet) at Bar Harbor, and 3.0 meters (10 feet) at Gloucester, Massachusetts, to 1.2 meters (4 feet) at Monomoy Point. Upland areas within the North Atlantic Zone are characterized by moderately rolling hills. The boundary between northern hardwood-conifer forest and eastern deciduous forest occurs in the vicinity of Cape Elizabeth, Maine.

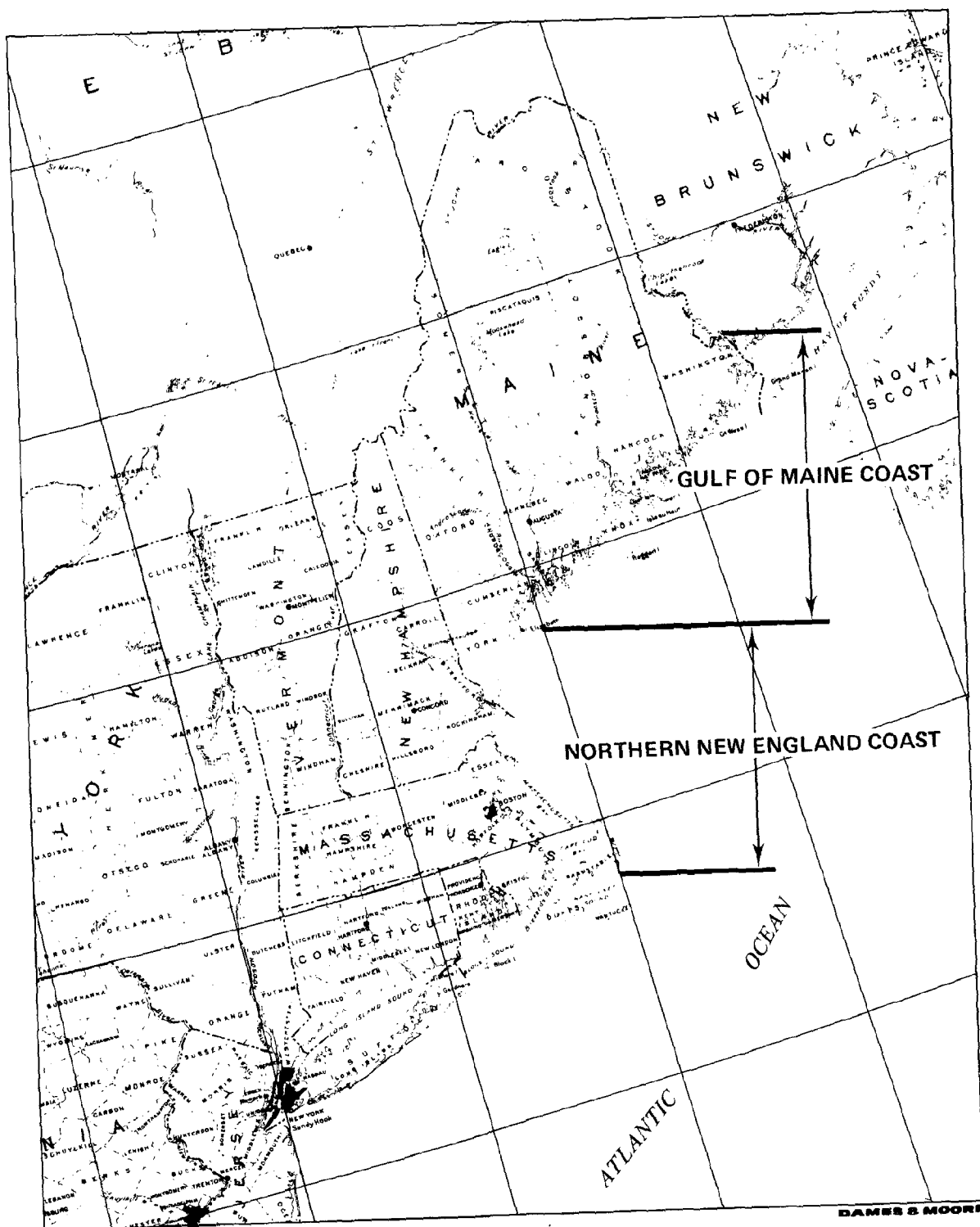


Figure 4. Major sections of the North Atlantic Zone.

#### 4.1.2 Special Land-Use Areas

The coastal area of the North Atlantic Zone generally is composed of densely populated and urbanized portions of Maine, New Hampshire, and Massachusetts.

Of 86 special land-use areas, 13 are Federally owned while the remaining areas are state owned (table 6). Acadia National Park, Roosevelt-Campobello International Park, and Moosehorn Wilderness are designated as Class I air quality areas. More than half of the areas are recreationally significant, ranging from the variety of Acadia National Park to open space and public beaches in other areas. Approximately one-third of the areas are significant as natural areas, and these areas range from remote islands, important to nesting birds, to hunting areas under management control. In addition, one-quarter of the areas have been denoted as having historic or cultural significance. Because of scale limitations, all of the historic sites in the urban areas of the North Atlantic Zone have not been shown on the maps. Scale limitations also prohibit showing approximately 25 wildlife management areas under the jurisdiction of the Maine Department of Inland Fisheries and Wildlife and approximately 180 small offshore islands under the jurisdiction of the same department or of the Bureau of Public Lands, Maine Department of Conservation. Information on these areas can be obtained from the appropriate state agency.

#### 4.2 RESOURCES OVERVIEW

The following paragraphs summarize the locations and habits of various species in the North Atlantic Zone. Only the more important species of the zone have been shown on the inventory maps due to scale limitations.

##### 4.2.1 Species with Special Status

Species with special status shown on the accompanying inventory maps include only those known to occur in the North Atlantic Zone which are designated as either threatened or endangered on Federal and state lists (table 7) and for which supporting data were available. Species proposed for consideration as endangered, threatened, or other classification are discussed only when appropriate in the applicable aquatic or terrestrial sections of this report.

Shortnose sturgeon (110) is an endangered species in the zone. This sturgeon formerly inhabited many of the large rivers in the zone, but now it is rare. This species is found in nearshore waters around favored estuaries such as the Kennebec River; spawning, if it occurs, is in May and June.

Six endangered whale species occur in the North Atlantic Zone. Of these, only the finback, humpback, and right whales prefer nearshore waters; the other species are infrequent visitors to the zone. The migratory occurrence in marine waters is from April to October for finbacks, and April through May and October through December for humpback and right whales.

The bald eagle (505) is the most familiar species with special status and is both endangered and threatened throughout its range. Maine is the only Atlantic coast state north of the Chesapeake Bay which harbors a breeding population of eagles. This wide separation between populations is considered to be the basis for the development of two subspecies: the northern bald eagle (Haliaeetus

Table 6. Fish and Wildlife Service land-use designations for the North Atlantic Zone.

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>MAINE</u>						
Moosehorn National Wildlife Refuge/ Moosehorn Wilderness*	X			X		
St. Croix Island National Monument	X				X	
Roosevelt-Campobello International Park*	X				X	
Cobscook Bay State Park		X				X
Quoddy Head State Park		X				X
Fort O'Brien State Park		X			X	
Roque Bluffs State Park		X				X
Petit Manan National Wildlife Refuge	X			X		X
Acadia National Park*	X			X	X	X
Lamoine State Park		X				
Howard L. Mendall Game Management Area		X		X		X
Fort Knox State Park		X			X	
Sandy Point Game Management Area		X		X		X
Fort Pownall State Park		X			X	
Fort Point State Park		X			X	X
Moose Point State Park		X				
Fort George State Park		X			X	
Holbrook Island Sanctuary State Park		X		X		
Warren Island State Park		X		X		X

\* Class I air quality area.

continued

Table 6 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>MAINE (cont'd)</u>						
Camden Hills State Park		X		X		X
Montpelier-General Knox Mansion		X			X	
Damariscotta Lake State Park		X				X
Peacock Beach State Park		X				X
Seal Island National Wildlife Refuge	X			X		
Franklin Island National Wildlife Refuge	X			X		
Pemaquid Restoration State Park		X			X	
Fort William Henry State Park		X			X	
Colonial Pemaquid State Park		X			X	
Fort Edgecomb State Park		X			X	
Reid State Park		X				X
Pond Island National Wildlife Refuge	X			X		
Fort Popham State Park		X			X	
Popham Beach State Park		X				X
Bradbury Mountain State Park		X				X
Mere Point Memorial State Park		X			X	
Wolf Neck Woods State Park		X				X
Two Lights State Park		X				X
Crescent Beach State Park		X				X
Scarborough Beach State Park		X				X
Scarborough Game Management Area		X				X
Rachel Carson National Wildlife Refuge	X			X		
Vaughan Woods State Park		X		X		
John Paul Jones Memorial State Park		X			X	
Fort McClary State Park		X			X	

continued

Table 6 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NEW HAMPSHIRE</u>						
Hilton Park		X				X
Odiorne Point State Park		X				X
Wallis Sands State Park		X				X
Rye Harbor State Park		X				X
Hampton Beach State Park		X				X
<u>MASSACHUSETTS</u>						
Salisbury State Beach		X				X
Isaac Sprague Bird Sanctuary		X		X		
Ram Island Wildlife Sanctuary		X		X		
Crane Pond Wildlife Management Area		X		X		X
Martin H. Burns Wildlife Management Area		X		X		X
Bill Forward Wildlife Management Area		X		X		X
Parker River National Wildlife Refuge	X			X		
Plum Island State Park		X				X
Georgetown-Rowley State Forest		X		X		X
Boxford State Forest		X		X		X
John C. Phillips Wildlife Sanctuary		X		X		
Harold Parker State Forest		X		X		X
Willowdale State Forest		X		X		X
B.W. Palmer State Park		X				
Thacher Island National Wildlife Refuge	X			X		X
Knight Wildlife Sanctuary		X		X		

continued

Table 6 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>MASSACHUSETTS (cont'd)</u>						
Lynn State Beach		X				X
Henry Cabot Lodge Wildlife Sanctuary		X		X		
Revere State Beach		X				X
Winthrop State Beach		X				X
Carson State Beach		X				X
Wollaston State Beach		X				X
Boston Harbor Islands State Park		X				X
Nantasket State Beach		X				X
Wompatuck State Park		X				X
Ames Nowell State Park		X				X
Standish Monument State Park		X			X	
Myles Standish State Forest		X		X		X
Myles Standish Wildlife Management Area		X		X		X
Shawme Crowell State Forest		X		X		X
Scusset State Beach		X		X		X
Nickerson State Park		X				X
Billingsgate Island Wildlife Sanctuary		X				X
Cape Cod National Seashore	X			X		X
Provincetown State Beach		X		X	X	X
Marconi Wildlife Management Area		X		X		X
Monomoy National Wildlife Refuge/ Monomoy Wilderness	X			X		

concluded

Table 7. Species with special status in the North Atlantic Zone.

Map No.	Species	Federal		State	
		Endangered	Threatened	Endangered	Threatened
<u>FISH</u>					
110	Shortnose sturgeon	X			
<u>MARINE MAMMALS</u>					
	Blue whale	X			
	Finback whale	X			
	Sei whale	X			
	Humpback whale	X			
	Right and bowhead whales	X			
	Sperm whale	X			
<u>BIRDS</u>					
505	Bald eagle	X	X		
507	Peregrine falcon	X			
<u>REPTILES AND AMPHIBIANS</u>					
613	Plymouth red-bellied turtle			MA	MA

leucocephalus alascanus), which breeds in Maine and northward, and the southern bald eagle (H. leucocephalus leucocephalus), which breeds in states south of the Chesapeake Bay and west to California. Although these populations are usually considered as geographically isolated, the potential for interbreeding occurs when eagles migrate along the coast after the nesting season. Eagles prefer to nest in tall trees or on ledges near water.

The peregrine falcon (507) is an endangered species which migrates along the entire U.S. Atlantic coast in spring and fall and stops occasionally on isolated islands or other remote areas to feed and rest. Data about its common stopover localities are scarce; wild remote islands or peninsulas generally are favored. Some of the known stopover areas for the North Atlantic Zone are shown on the accompanying inventory maps.

The Plymouth red-bellied turtle (613) is a recent addition to the Federal list of endangered species and also is designated as endangered and threatened in Massachusetts. A critical habitat for this species is shown on the maps at grid reference CS63; this Federally designated area is the only known habitat of the Plymouth red-bellied turtle. This species also may be found on Naushon Island (grid reference CR59) because a similar habitat occurs on this island.

#### 4.2.2 Aquatic Resources

Brief descriptions of the life histories of the major commercially, recreationally, and ecologically important aquatic organisms which occur within the North Atlantic Zone are provided below.

##### Plants

Economically, the most important aquatic plant in the North Atlantic Zone is Irish moss, which is commercially harvested in Maine. Harvesting areas for this alga are shown on the maps; however, grazing by invertebrates or overharvesting may change the locations of valuable beds. Irish moss is found in intertidal areas year-round. Although it is tolerant of broad ranges of salinity and temperature, and its depth depends on light availability and substrate, most harvesting occurs in water depths of about 1.5 meters (5 feet). The preferred substrate for Irish moss is a solid, gently sloping, unsilted, and moderately unsheltered rocky area, particularly bedrock ledges.

Rockweed, another commercially important alga, is used as an emulsifier for food. Rockweed is found in intertidal areas year-round; it dominates exposed tide pools of the North Atlantic Zone where it is firmly attached to rocks.

##### Invertebrates

Two species of worms are harvested commercially in the zone: bloodworms and sandworms. Bloodworms are found in the intertidal zone near the low-water mark and in soft organically rich mud in deeper waters. Sandworms are found in substrates varying from fine mud to rocks and stones, but they are most common near sheltered shores, particularly on sandflats at river mouths. Bloodworms are more valuable commercially than sandworms; however, areas where both species can be found are shown on the accompanying maps.

Commercially important shellfish in the zone include: mussels, oysters, scallops, clams, shrimp, and lobsters. Because of their ubiquitous occurrence, many shellfish species have wide ranges in their distributions for at least part of their life history. Only the most important areas with large shellfish concentrations have been shown on the maps.

Mussels are found throughout the zone on hard, rocky, intertidal substrates and prefer areas with strong currents.

The eastern oyster prefers shallow estuarine areas, particularly hard, flat areas and offshore bars. Although oysters may occur at greater depths, they are most common at water depths of less than 1 meter (3 feet). Oysters spawn in spring and summer, depending on water temperature, and have a 4- to 5-month growing season in the North Atlantic Zone.

Bay scallops generally are found in shallow estuarine eelgrass beds but may occur to depths of 18 meters (60 feet). Scallop spawning is temperature dependent and occurs in early summer in the zone.

The deep-sea scallop generally is found on sand or gravel to a depth of 18 meters (60 feet). The preferred habitat is an area of relatively constant temperature and salinity and strong currents. Spawning occurs from early summer to early fall.

Surf clams inhabit coarse substrate, preferring gravel and sand to silt. In the North Atlantic Zone, surf clams occur in shallow, nearshore waters and spawn from June through mid-August.

Soft shell clams are second only to lobsters as a commercially important invertebrate species in the North Atlantic Zone. Soft shell clams inhabit intertidal mudflats, sandflats, and gravel beaches; dense populations occur on mudflats near the low-water mark. Soft shell clams have a wide salinity tolerance from freshwater to seawater, but sudden changes in salinity can cause mortality. In the North Atlantic Zone, spawning occurs from June to mid-August.

Hard clams, or quahogs, are commonly found on sand or sandy clay. These clams can tolerate high-pollution and low-oxygen levels; thus, competition is minimal in many areas where hard clams thrive. This species is found primarily in estuaries and spawns in the summer.

Ocean quahogs are found on soft substrate, preferably fine or silty sand, in nearshore waters of the North Atlantic Zone. Their spawning period extends from late June to October.

The northern shrimp is a commercially important species. It is usually found offshore over organic substrates in water temperatures from 4.5°C to 8°C (40°F to 46°F) and at water depths of 110 to 180 meters (360 to 600 feet). Shrimp migrate inshore in late winter to spawn where water depths range from 37 to 90 meters (120 to 300 feet). Juveniles and immature shrimp remain inshore during the first 10 to 20 months and migrate offshore during their second winter to third summer.

Lobsters are the most valuable shellfish of the North Atlantic Zone fishery and occur both as larvae and adults throughout coastal waters. Adults are more tolerant of low salinities than larvae, but both adults and larvae are sensitive to temperature, which ranges optimally from 10°C to 17.5°C (50°F to 64°F). Lobsters migrate to shallow water in the spring and return to deep water in the fall as inshore waters become cool.

### Fish

Commercially important fish in the North Atlantic Zone include the following: blueback herring, alewife, Atlantic herring, winter flounder, Atlantic mackerel, Atlantic cod, pollock, hake, haddock, and bluefin tuna. Important sport fish include the following: Atlantic salmon, striped bass, white perch, rainbow smelt, Atlantic tomcod, and tautog, together with commercial species such as tuna and winter flounder. Because of the ubiquitous occurrence of most of these fish, many have wide ranges in their distributions for at least part of their life history. Only the most important areas with large concentrations have been shown on the maps.

a. Freshwater species. Freshwater streams and ponds support an important sport fishery. Coldwater streams provide habitat for brook, rainbow, and brown trout. Warmwater sport species include yellow perch, largemouth and smallmouth bass, and chain pickerel. These species spend their life cycles in freshwater.

b. Anadromous species. Anadromous fish spend most of their lives in an ocean environment but spawn in freshwater rivers.

Atlantic sturgeon is an anadromous fish which spawns during May and June in the freshwater reaches of large coastal rivers. After the eggs hatch, the young sturgeon swim downstream and mature offshore.

Blueback herring and alewife, though distinct species, are collectively called river herring. These anadromous species spawn in late-April to mid-May and return to the ocean by mid-August. Larvae use both freshwater areas and estuaries as nurseries, but overwinter in estuaries their first year. Although used for food, commercial fisheries for river herring now are generally offshore; only small commercial and sport fisheries are present along the coast.

The anadromous American shad has decreased in population because of increased pollution and streamflow regulations and is presently of little commercial importance. Adults spawn in spring in riverine areas with extensive flats, often near creek mouths. After spawning, adults return to the ocean, where they are found from the surface to a depth of 120 meters (400 feet). Juveniles remain in the river through the fall and move to the sea when temperatures fall below 16°C (61°F). North Atlantic shad populations overwinter in the middle Atlantic Ocean.

The Atlantic salmon is an anadromous sport fish which lives most of its life in the ocean to depths of 90 meters (300 feet) and spawns in freshwater river areas usually over a gravel substrate. Spawning varies from stream to stream but generally occurs from mid-May to late-June or mid-July to mid-September. Adults may spawn several times during their life, but always return to the sea. Juveniles inhabit local rivers for periods of 1 to 3 years before going to sea.

The white perch is an important estuarine sport fish whose commercial value is increasing. This species is found to depths of 11 meters (36 feet); it overwinters in deeper portions of estuaries and tidal creeks and spawns in spring and early summer in fresh to brackish waters. Nursery areas occur at the freshwater-saltwater interface.

The striped bass is a summer transient in north Atlantic waters, and it migrates to the estuaries of the Middle Atlantic Zone to spawn and overwinter. Striped bass is an important fish in the zone and is found near the shore and in estuaries and rivers, normally to depths of 9 meters (30 feet).

The rainbow smelt is an anadromous species which spawns from March through May as the waters become warm. Spawning occurs in both fresh and brackish water, usually near or just above the tideline. After spawning, adults return to nearshore waters. After hatching, larvae drift downstream into estuaries and move to deeper estuarine water over summer. As water temperatures drop in the fall, juveniles move higher in the water column and form schools with adults. The schools remain nearshore and are found from the surface to about 9 meters (30 feet).

Atlantic tomcod is a sport fish which dwells in coastal and brackish waters. Spawning occurs in mid-winter, and the tomcod prefers sandy or gravelly shoals of estuaries and rivers. Adults occur in estuaries, bays, rivers, and along the shore to depths of 11 meters (36 feet).

Most brook trout remain in freshwater streams; only those which are anadromous are called sea-run, or salter, brook trout. Sea-run brook trout is a sport fish which migrates upstream in late spring. It spawns in the fall and then returns to the sea. The eggs hatch the following spring, and the young return to the sea in the fall with the adults.

Coho salmon is an anadromous sport fish which has been introduced in the North Atlantic Zone. Upstream migration occurs in the fall and spawning occurs in gravelly riffles from November to January. Eggs hatch in the spring and the juveniles may move downstream immediately or wait until the spring of the next year or the following year. Juveniles remain near stream mouths several months before moving to sea.

c. Catadromous species. Catadromous species spawn in the ocean but live as adults largely in freshwater lakes and rivers.

The American eel is a ubiquitous species, common in rivers and streams throughout the North Atlantic Zone. Eels are catadromous fish which spawn in the Sargasso Sea in autumn. Juvenile elvers return to coastal waters in late winter and early spring. Locally, eels are fished commercially and recreationally for both food and bait.

d. Estuarine-dependent species. Estuarine-dependent species require low salinities, usually in estuaries and marshes, during part of their life cycle. Representative estuarine-dependent species in the North Atlantic Zone are Atlantic herring, winter flounder, and cunner.

The Atlantic herring is an oceanic species which, in the North Atlantic Zone, spawns on George's Bank in spring, summer, and fall. Larvae move shoreward to lower salinity areas in the fall and overwinter in upper estuaries.

Winter flounder prefers eelgrass beds and is found in coastal waters and estuaries to depths of 90 meters (300 feet). Found inshore from fall to spring, flounder spawns in estuaries from January to May and moves offshore in summer. Flounder is an important commercial species whose recreational popularity is increasing.

Cunner is an important sport species found on hard substrate and near wharves or ledges to depths of 73 meters (240 feet). Cunner is an inshore species which occasionally is found in estuaries and spawns inshore from late April through September.

e. Oceanic species. Oceanic species are visitors to shallow or nearshore ocean waters (within the three-mile limit) either periodically as part of their life history or occasionally in the quest for food.

Atlantic mackerel occurs offshore and inshore and occasionally enters estuaries. Mackerel winters offshore on the Continental Shelf and moves shoreward in spring; it is found to depths of 180 meters (600 feet). Spawning occurs in the middle Atlantic Ocean and the Gulf of St. Lawrence.

Atlantic halibut is found on coarse substrates between rocks and ledges at depths exceeding 90 meters (300 feet). It is an important commercial species that is most common on offshore banks.

Atlantic cod is one of the most valuable commercial fish in the North Atlantic Zone. Cod is primarily a bottomfish or groundfish and prefers hard, coarse substrates from shore to depths of 370 meters (1,200 feet). Spawning occurs at sea from December to April.

Pollock is found throughout the water column to depths of 73 meters (240 feet). Populations move inshore in spring and offshore in the fall and winter. Pollock spawns in fall and early winter.

Haddock is another commercially important groundfish found in areas of hard, coarse substrates. Most spawning occurs in March and April on George's Bank. Overwintering occurs in deep water and may extend as far south as Cape Hatteras. Although haddock does not occur in estuaries, it does prefer shallow waters during the summer.

Hake includes several species, all of which have similar habits. Hake is a groundfish found primarily over sandy to muddy bottoms (not rock), and it spawns at sea in summer and early autumn. This species is growing in commercial importance, particularly as a feed product.

Bluefin tuna is a sport and commercial fish found to depths of 90 meters (300 feet). In the North Atlantic Zone, it occurs both inshore and offshore in the summer and moves offshore or south to winter. Bluefin tuna does not spawn in the North Atlantic Zone.

Tautog is a sport fish in the North Atlantic Zone and normally is found inshore to depths of 18 meters (60 feet). It is a groundfish which occurs over hard bottoms and near wrecks and jetties. Spawning occurs from May through August in weedy inshore areas. The tautog moves inshore in spring and offshore in the fall, depending on the water temperature.

American plaice is an important commercial groundfish species normally found in offshore waters. Generally the species and its spawning grounds are found at depths of 90 meters (300 feet); plaice spawning occurs in the spring.

The North Atlantic Zone historically has been rich in marine and estuarine resources. Much of the early exploration of the land was related to commercial fishing, particularly on George's Bank. Currently, at George's Bank both commercial and sport fisheries are important, but the bank is not within the scope of the study region defined for this report. Detailed information on fish life-history characteristics for the North Atlantic Zone can be obtained from Bigelow and Schroeder (1953) and from Clayton, et al., (1976).

#### Mammals

Marine mammals of the North Atlantic Zone generally prefer offshore waters, but several species of whales and porpoises are common inshore following storms. Marine mammals common to coastal waters are the harbor porpoise, pilot whale, minke whale, harbor seal, and gray seal; some endangered whales are found infrequently near to shore. The harbor and gray seals are the dominant species, and they occur on rocky offshore ledges and remote islands throughout the zone. More than 200 sites in the zone are used by the seals as crawlouts or whelping areas, but only regularly used and significant areas have been mapped.

#### 4.2.3 Terrestrial Resources

The North Atlantic Zone is rich in terrestrial resources, but many upland and estuarine species populations are decreasing because of continued development and urbanization. The diverse habitats within the coastal zone harbor a large variety of terrestrial flora and fauna.

#### Birds

Upland forests, freshwater swamps, coastal marshes, and offshore islands all occur within the North Atlantic Zone. Within these habitats, birds are one of the more conspicuous and important terrestrial groups. The large bird population of the North Atlantic Zone consists of shorebirds, wading birds, waterfowl, raptors, and seabirds.

Areas mapped for bird species were selected based on the area's importance to the species within the geographic interval. Thus, no absolute population cut-off points were used throughout the inventory, but the significance of the site for the species within the interval was considered. Mapped areas were selected by using published information concerning known areas of importance.

a. Shorebirds. Shorebirds include sandpipers, plovers, turnstones, gulls, and terns. These birds live around shore and intertidal areas. Some bird species are found in the North Atlantic Zone throughout the year while others

winter farther south and return in April or May to nest. Egg laying and hatching generally are complete by late July and the birds return to the south in late August through October. The North Atlantic Zone is the northern breeding limit for the roseate tern.

b. Wading birds. Wading birds are found in marsh areas of the coastal zone. Herons, bitterns, cranes, ibises, egrets, rails, and related species which compose this group can be found near freshwater as well as saltwater. Wading birds arrive in the North Atlantic Zone from late March through May, egg laying and hatching generally are complete by early July, and the southward migration occurs from mid-August to mid-October. Many wading birds, such as snowy egrets, glossy ibises, and great blue, little blue, Louisiana, and black-crowned night herons, are at the northern limits of their range in the North Atlantic Zone.

c. Waterfowl. Species of waterfowl are important in the North Atlantic Zone as aesthetic, recreational, and economic resources. Hunters and bird watchers seek waterfowl in the marshes, inlets, and coves. Brackish marshy areas are particularly important habitats for waterfowl. Swans, geese, dabbling ducks, and diving ducks use most of the available habitats during migration, wintering, and breeding. For example, dabbling ducks generally can be found in freshwater areas while diving ducks are found in open and nearshore waters as well as in salt marshes. Most waterfowl species in the region breed farther north and are only transients or winter residents; however, the common eider and harlequin duck are local breeders.

d. Raptors. The groups, hawks and owls, are discussed as raptors in this report. Owls generally are found in more inland areas while hawks are found along the coast and near marshes and bays. Owls and many hawks generally are permanent residents of the zone. Ospreys are a notable exception in the zone because they are migratory raptors. The North Atlantic Zone affords a nesting area for ospreys.

e. Seabirds. Seabirds, like petrels and shearwaters, spend most of their lives at sea and come to land only to nest. These seabird species nest in May and June, hatching generally is complete by late July, and the birds depart in September and October. Isolated islands and rock ledges are the preferred nesting sites for these seabirds. In the North Atlantic Zone, the offshore islands are valuable habitats for many species of seabirds. The zone also represents the southern breeding limit for some species, such as the common puffin, Leach's petrel, and black guillemot.

f. Songbirds and others. Many other species of birds are known to nest in, or migrate through, the North Atlantic Zone. In the spring, the zone is a nesting, breeding, and migratory area for the American woodcock. If information was available, species were indicated on the inventory maps; however, many species pass through this area, and only the more important species have been identified.

#### Reptiles and Amphibians

Because of the cool climate, populations of reptiles and amphibians are considerably smaller in the North Atlantic Zone compared to the populations found

farther south. Aquatic habitats, both salt and fresh, are crucial in supporting the existing populations. These animals do not migrate extensively.

### Mammals

Important upland mammals include the gray and red fox, bobcat, raccoon, opossum, eastern cottontail rabbit, eastern gray squirrel, and aquatic furbearers. These species are more likely to be found in the less developed portions of the zone.

Deer is the most important big game species present, but black bear and moose also are found occasionally in uplands in the zone. Little information is available on these species except for that derived from surveys taken on deer wintering areas or yards. Yards are where deer herds congregate to avoid harsh winter weather; however, herd concentrations in the yards vary markedly depending upon the severity of the winter. Not all yards are used every year, but all provide important shelters for deer.

Beaver, mink, muskrat, and otter are the aquatic furbearers. Beaver is the most important commercial species because of its fur. Also beaver is ecologically significant because of its ability to modify freshwater wetlands. Mink and otter are expected in greater abundance in undisturbed freshwater wetlands, while muskrat generally is found in salt marsh areas, although in smaller numbers than in the Middle Atlantic Zone. The weasel prefers freshwater wetlands; little data are available on the other furbearers.

### 4.3 GULF OF MAINE COAST (GRID REFERENCE FW30 TO DU02)

The northernmost section of the study region extends from the Canadian border to Cape Elizabeth, Maine. Rocky headlands and numerous offshore islands comprise an attractive environment for many species. Numerous rivers and estuaries extend inland, and the shoreline is characterized by high-energy coastal environments. Tidal range in this section is high; for example, it exceeds 6 meters (20 feet) in Passamaquoddy Bay. Although marshes are few and tidal flats are not extensive, the tidal range and rugged coast provide habitats for numerous intertidal communities. Upland areas of this section generally are forested with mixed hardwoods and coniferous trees and are usually less than 60 meters (200 feet) in elevation. East of the Penobscot River, the region is undeveloped and rich in both aquatic and terrestrial resources. The biotic resources for this section are keyed geographically using north-south UTM grid swaths.

### Aquatic Resources

a. Widespread species. The Gulf of Maine Coast has not been exploited by fishermen, and it supports a variety of commercially or recreationally important aquatic species. Irish moss, rockweed, and marine invertebrates are abundant. Representative areas for commercial harvesting of deep-sea scallops, soft shell and hard clams, bloodworms, and sandworms are shown on the inventory maps. Lobsters are ubiquitous; therefore, no lobster concentrations or harvesting areas have been shown. Northern shrimp is commercially harvested in deep water.

Eels are found along the entire coast and in most of the streams too numerous to portray on 1:250,000-scale maps, but they are a limited sport fishery. Alewives also are widespread; representative spawning streams have been mapped for this commercially important species. American shad, Atlantic herring, winter flounder, rainbow smelt, Atlantic tomcod, Atlantic halibut, Atlantic cod, pollock, haddock, and hake occur throughout coastal waters and in many estuaries. These fish have both commercial and recreational significance and generally can be found throughout the year. Striped bass and bluefin tuna are present in the summer, and although abundant, they have not been used to their greatest recreational potential.

Important recreational anadromous species include alewife, blueback herring, shad, sea-run brook trout, and Atlantic salmon in cold water. Recreational fisheries also exist for brown, rainbow, and brook trout in cold water, and warmwater species include largemouth and smallmouth bass, white and yellow perch, and chain pickerel.

b. Geographic inventory. Coastal concentrations of Atlantic herring between grid references FV66 and FV43 and in Passamaquoddy Bay attract a variety of marine mammals, such as minke, humpback, finback, and right whales, and harbor porpoises. The redfish also is found in Passamaquoddy Bay in spring and fall. It is unusual to find this bottom species so close to shore, because it is most common at depths exceeding 90 meters (300 feet).

Some of the few remaining natural Atlantic salmon spawning runs exist between grid references FV33 and EV70. Important streams where salmon spawn include Dennys River, Cathance Stream, and the East Machias, Machias, Chandler, Pleasant, and Narraguagus Rivers. Spawning generally occurs in one of two periods, either mid-May to late June, or mid-July to mid-September.

Numerous assemblages of deep-sea scallops, soft shell clams, bloodworms, and sandworms have been mapped between grid references EU69 and EU27, and these areas represent places for potential commercial harvesting. A spawning run for Atlantic salmon on the Union River and several seal crawlouts are present.

The Penobscot River (grid reference EV13) is significant as a spawning run for Atlantic sturgeon and salmon in May and June.

Atlantic salmon also spawns in the Sheepscot River, which is between grid references DU53 and DU43. This same segment includes a major harbor seal whelping site.

The Kennebec River (grid reference DU33) is one of the few remaining streams inhabited by the endangered shortnose sturgeon. This river is the only North Atlantic Zone waterway where this species recently has been reported. Atlantic sturgeon also spawns in the Kennebec River; both species spawn in May and June.

### Terrestrial Resources

a. Widespread species. Shorebird migratory concentration areas and nesting or overwintering areas for shorebirds and waterfowl, particularly common eider and black duck, are widespread throughout the Gulf of Maine Coast. Many

important nesting areas occur on the offshore islands for a variety of shore-birds, seabirds, and waterfowl, as well as raptors.

Mammals also are widespread and found year-round. Important resources are the deer in the uplands, beaver in freshwater wetlands, and muskrat in saltwater marshes and wetlands. Other important mammals include black bear, moose, bobcat, red fox, and gray fox throughout the region, and mink, weasel, and otter near freshwater wetlands.

b. Geographic inventory. Several bald eagle nests occur between grid references FV65 and FV33. Cobscook Bay is an important overwintering area for bald eagles and black ducks, and it serves as a migratory area for the northern phalarope which is a rare visitor to land. Moosehorn National Wildlife Refuge is noted as a nesting, breeding, and migratory area for the American woodcock in the spring. This refuge is an important migratory and nesting area for gulls, terns, waterfowl, marsh hawks, and barred, saw-whet, and great horned owls. One of only two razorbill auk nesting areas in the United States is located in this segment, and this locale represents the southern limit of the auk's range. In addition, this segment includes the largest U.S. breeding area for common eider, a species which breeds only in Maine. Several deer yards are found in the area. In nearby Canadian waters, Machias Seal Island (grid reference FV52) is a seabird nesting area for the common puffin, razorbill auk, and northern phalarope, as well as common and arctic terns.

The area between grid references FV22 and EV90 includes several bald eagle and osprey nests, important overwintering areas for dabbling and diving ducks, and several great blue heron rookeries. These rookeries are near the northern limits of the great blue heron's range. Petit Manan Island (grid reference EV91) is the northernmost nesting area in the United States for roseate terns and supports the largest common and arctic tern nesting colonies, 700 pairs per colony, in the Gulf of Maine section.

Between grid references EV70 and EU57 are several bald eagle nests and deer wintering yards. Great and Little Duck Islands (grid reference EU69) support the largest nesting areas for Leach's petrel (18,000 pairs) and black guillemot (650 pairs) in the United States. This is the approximate southern limit of the breeding grounds for these species.

Other bald eagle and osprey nests occur between grid references EU47 and EU27. The largest breeding area in the United States for the harlequin duck is located on Isle au Haut (grid reference EU37) and contains approximately 90 percent of the harlequin duck population.

Between grid references EU14 and EU04, additional bald eagle and osprey nests are mapped; a major bald eagle overwintering area is located along the Penobscot River. Matinicus Rock (grid reference EU14) supports the only U.S. breeding area for the common puffin; it is the second and largest of the two U.S. razorbill auk breeding areas, and it is the third largest breeding area for Leach's petrel, and the fifth largest breeding area for the black guillemot.

Bald eagle nests also are mapped between grid references DU33 and DU22, particularly at Merrymeeting Bay. The bay is an important bald eagle wintering area as well as a major migratory area for waterfowl.

#### 4.4 NORTHERN NEW ENGLAND COAST (GRID REFERENCE DU02 TO DR19)

The Northern New England Coast extends from Cape Elizabeth to Cape Cod and includes Monomoy Island. The shoreline of this section is not as deeply incised nor as rocky as the shoreline north of Cape Elizabeth, and fewer offshore islands occur. The sand and gravel beaches of the northern part of the section are replaced by sandy beaches in the southern part of the area near Cape Cod. Scattered rocky headlands dominate the shoreline around Cape Ann. Elevations in the section generally are less than 15 meters (50 feet) but occasionally exceed 30 meters (100 feet) as, for example, at Cape Ann and Cape Cod. Most of this coastline is a high-energy environment except for the shelter of Cape Cod Bay. Plum Island, near the mouth of the Merrimack River, is the first major barrier beach south of the Canadian border. The upland areas of this section are rolling hills, and where not urbanized, the upland is characterized by deciduous forest. Biotic resource descriptions in the Northern New England Coast section are keyed geographically to east-west UTM grid swaths.

##### Aquatic Resources

a. Widespread species. The diversity of aquatic species in this section is comparable to that of the Gulf of Maine Coast, but overfishing, pollution, and destruction of aquatic habitats by river control measures and shoreline development have reduced nearshore populations. The Northern New England Coast has many port facilities, and because of the area's large human population, much of the offshore catch is landed and used locally rather than at more northern ports.

Aquatic plants in this section have little commercial importance. Bloodworms and sandworms also have limited commercial value. The American lobster, which inhabits the inshore areas along most of the coast, is fished commercially primarily offshore on George's Bank. George's Bank provides most commercial fishing for the entire zone. Many other important aquatic species in this section are sport fish or nearshore populations of oceanic fish taken commercially only well offshore.

Alewife, shad, blueback herring, winter flounder, rainbow smelt, Atlantic herring, tomcod, cod, halibut, pollock, haddock, and hake are taken commercially along the coast and in several estuaries. Striped bass and bluefin tuna are summer migrants; sport fishing for both species is more important in this section than it is to the north of Cape Elizabeth. Other nearshore species are found year-round and are of recreational value, although in the past they were important commercial fish.

An important sport fishery exists for brook trout and brown trout in cold-water streams. Warmwater sport species--white and yellow perch, largemouth and smallmouth bass, and chain pickerel--are caught in the numerous freshwater streams and ponds of this section. Many large representative areas are noted on the map as streams where alewife, smelt, and tomcod spawn, but many more small streams also support these species.

b. Geographic inventory. Two of the more significant seal crawlout areas in this section occur at grid reference DU01. These areas are the only crawlouts identified in this section.

Extensive shellfish beds are a significant aquatic resource between grid references DS25 and DR19. These beds support commercially harvestable numbers of shellfish, such as eastern oysters, bay scallops, deep-sea scallops, surf clams, soft shell clams, hard clams (quahogs), and ocean quahogs.

Natural oysterbeds exist on the Piscataqua River between grid references CT78 and CT76. The Piscataqua River and Great Bay also provide the springtime spawning area for the Atlantic sturgeon, and the autumn spawning area for the recently introduced coho salmon.

The only lobster concentrations in the North Atlantic Zone which were mapped are between grid references CT75 and CT74. The Merrimack River supports spawning habitats for Atlantic sturgeon and Atlantic salmon in May and June.

North River (grid reference CS56) supports Atlantic salmon spawning and also is both a national natural landmark and a state scenic and recreational river.

#### Terrestrial Resources

a. Widespread species. Numerous nesting and migratory areas for shorebirds, seabirds, and waterfowl are located along the coast. Typical sites occur on offshore islands, coastal marshes, beaches, and other undeveloped natural areas amidst urban sprawl. Urbanization along the Northern New England Coast has reduced populations of many important terrestrial mammals. Remote areas support limited populations of beaver, mink, otter, and muskrat; however, data are scarce. Muskrat populations have not been depleted, but much of their coastal marsh habitat has been destroyed.

b. Geographic inventory. Between grid references DU12 and CT89 are several important sites of shorebird nesting, dominated by herring and great black-backed gulls. Two rare piping plover nesting areas occur at grid references CU92 and CT79. In addition, the small heronries at grid reference CU91 are some of the most diverse in the North Atlantic Zone; they support snowy egret, glossy ibis, little blue heron, Louisiana heron, and the black-crowned night heron, all of which are near the northern limits of their range.

The second and fourth largest nesting areas for herring gulls (4,000 pairs combined), and the first and third largest great black-backed gull nesting areas (1,760 pairs combined), occur offshore between grid references CT76 and CT75 on the Isles of Shoals. These same islands support a rookery of little blue heron, snowy egret, glossy ibis, and black-crowned night heron.

Between grid references CT54 and CS68 are numerous nesting areas for gulls and arctic, common, and least terns. Parker River National Wildlife Refuge, the most significant refuge in this section, is noted for the waterfowl, seabirds, and songbirds which use it for nesting and as a migratory stop in the spring and fall. The largest North Atlantic Zone heronry is on House Island (grid reference CT51); it supports approximately 950 pairs of cattle, great, and snowy egrets and Louisiana, little blue, and black-crowned night herons, and glossy ibises.

Clarks Island (grid reference CS65) is a significant heronry area. This island supports the second largest heronry in the North Atlantic Zone and is used

by snowy and great egret, little blue and black-crowned night heron, and the glossy ibis.

The Federally designated critical habitat of the Plymouth red-bellied turtle is in a small area at grid reference CS63; this area is the only confirmed habitat for the species. This turtle is a recent addition to the Federal endangered species list, although it has been listed as endangered in Massachusetts for some time.

Monomoy National Wildlife Refuge (grid reference DR19) is an important refuge, since it supports the largest U.S. nesting colonies of common terns and herring gulls (2,100 and 4,900 pairs, respectively); the second largest U.S. great black-backed gull colony (900 pairs); the largest laughing gull colony north of New Jersey (200 pairs); and the third largest U.S. roseate tern colony (400 pairs). The refuge also is an important migratory stopover and resting area for shorebirds, seabirds, waterfowl, hawks, and owls.

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## PART 5

### MIDDLE ATLANTIC ZONE

#### 5.1 INTRODUCTION

For best results, much of the preparatory information in parts 1, 2, and 3 should be read before using the maps or using the information in this part. This part presents some of the physiographic, land-use, and geographic features of the Middle Atlantic Zone and the characteristics and habits of some of the major biological resources.

##### 5.1.1 Physical Description

The Middle Atlantic Zone (figure 5) comprises approximately 35 percent of the study area, and extends from Cape Cod, Massachusetts, to Cape Charles, Virginia, on the southern tip of the Delmarva Peninsula (grid reference DR19 to VR17), a total distance of 965 kilometers (600 miles).

The ecological inventory of the Middle Atlantic Zone is covered by portions of the following USGS 1:250,000-scale maps:

- Providence, RI; MA; CT; NY
- Hartford, CT; NY; NJ; MA (includes portion of Albany, NY; CT; MA; NH; VT)
- New York, NY; NJ; CT
- Newark, NJ; PA; NY
- Wilmington, DE; NJ; PA; MD
- Salisbury, MD; DE; NJ; VA
- Baltimore, MD; PA; VA; WV
- Washington, DC; MD; VA
- Richmond, VA; MD
- Norfolk, VA; NC
- Eastville, VA; NC; MD.

The Middle Atlantic Zone has a temperate climate, but the temperature of nearshore waters and waters of the larger estuaries and bays is influenced by the cold Labrador Current and the warm Gulf Stream. The coastline is characterized by numerous long, high-energy, sandy beaches in the north and low-profile barrier island and beach dune systems in the south. Extensive marshes and estuaries are located behind the barrier islands.

The Middle Atlantic Zone is divided into several major sections: Southern New England Coast, New York Bight, Delaware Bay and Delaware River, Delmarva Shore, and the Chesapeake Bay. The Southern New England Coast section has an irregular coastline with several large islands, two large bays, and four major sounds. The major subdivisions of this section are Nantucket, Rhode Island, and Block Island Sounds, and Long Island Sound. The New York Bight and the Delmarva

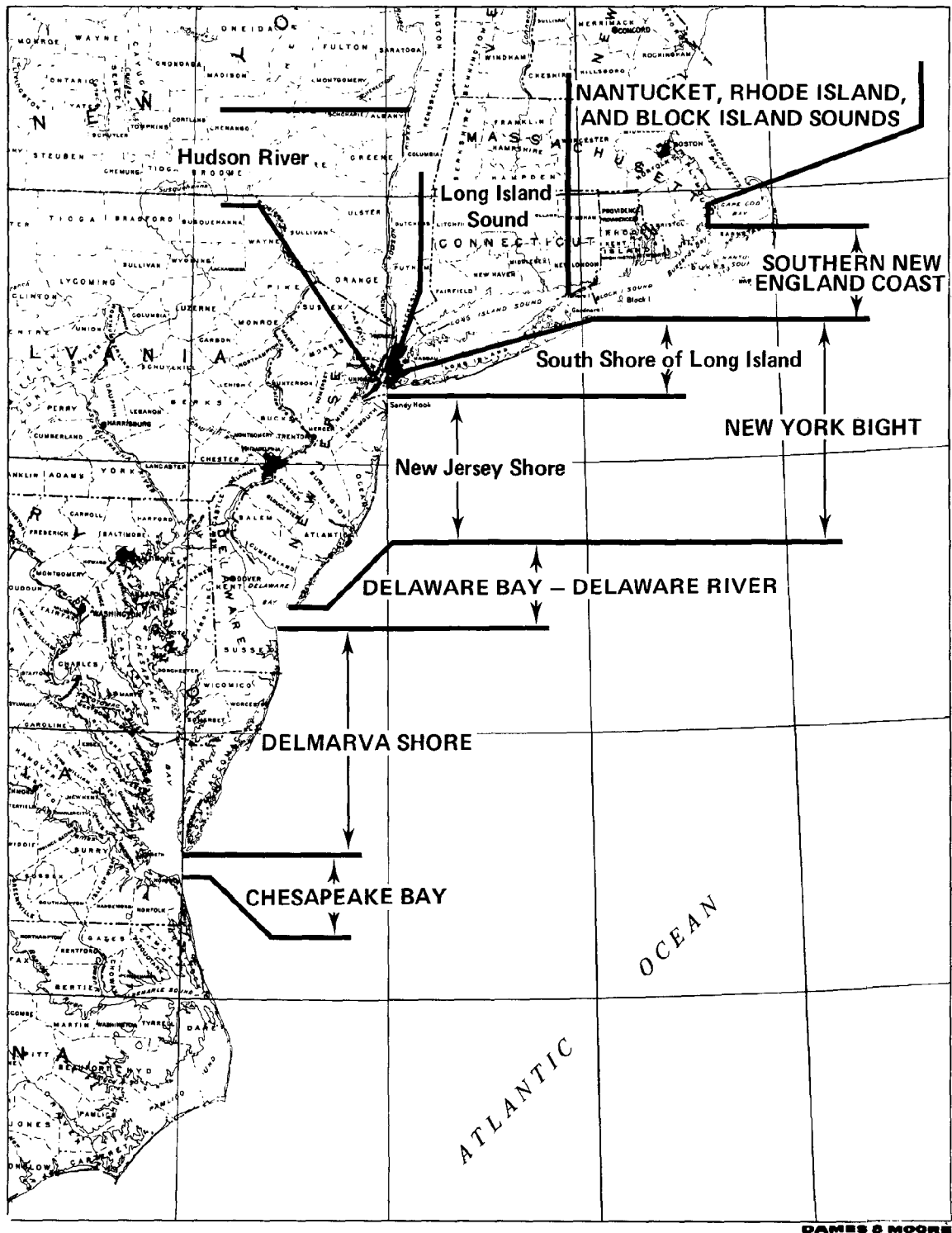


Figure 5. Major sections and subsections of the Middle Atlantic Zone.

Shore sections are fronted by wide, sandy, high-energy barrier island beaches behind which lay estuarine bays and marshes. The New York Bight is subdivided into the Long Island South Shore, the Hudson River estuary, and the New Jersey Shore. Two large estuarine embayments, the Delaware Bay and the Chesapeake Bay, are characterized by extensive marshes along their shores, and both bays have increasing salinity gradients downstream to their mouths.

The estuaries and shallow coastal waters of the Middle Atlantic Zone are highly valued ecosystems that cover an estimated 19,425 square kilometers (7,500 square miles). Estuaries, such as the Chesapeake Bay have considerable influence on sport and commercial fisheries. Of several hundred fish and shellfish in the Middle Atlantic Zone, only about 35 species are presently of significant commercial value.

The rivers, bays, and inlets in the zone are surrounded by highly productive forested and nonforested wetlands. A majority of the terrestrial habitat in this zone consists of oak and pine forests, although other main habitats are present, such as farmlands, pastures, and urban areas.

#### 5.1.2 Special Land-Use Areas

A total of 312 special land-use areas (natural, historical, cultural, recreational, or multiple-use) have been identified in the Middle Atlantic Zone (see table 8).

Of these land-use areas, 56 are Federally owned, 239 are state owned, and the remaining 17 are private areas. Within the Middle Atlantic Zone only the Brigantine Wilderness is designated as a Class I air quality area. More than 66 percent of the areas are significant recreationally, but these areas include refuges and hunting areas in addition to forests, parks, and open spaces. Approximately 50 percent of the areas are significant natural areas and range from remote islands important as rookeries to managed hunting areas. Thirty-one areas have historic or cultural significance. Because of scale limitations, all of the historic sites in the urban areas of the Middle Atlantic Zone have not been shown on the maps.

### 5.2 RESOURCES OVERVIEW

The following paragraphs summarize the various species in the Middle Atlantic Zone. Only the more important species of the zone have been shown on the inventory maps due to scale limitations.

#### 5.2.1 Species With Special Status

Thirty-eight species in the Middle Atlantic Zone are listed as Federal or state threatened or endangered species (table 9). These species include five plants, four fish, nine reptiles, three amphibians, ten birds, six marine mammals, and one land mammal; five plants legally protected in New York also are listed. Only those species with known distributions are mapped. Several of these species are of particular note because they occur throughout the Middle Atlantic Zone.

Table 8. Fish and Wildlife Service land-use designations for the Middle Atlantic Zone.

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>MASSACHUSETTS</u>						
Nantucket Island National Wildlife Refuge	X			X		X
Nantucket State Forest		X		X		
Nomans Land Island National Wildlife Refuge	X			X		
Martha's Vineyard State Forest		X		X		X
Penikese Island Wildlife Sanctuary		X		X		
Crane Wildlife Management Area		X		X		X
Ram Island Wildlife Sanctuary		X		X		
Fort Phoenix State Beach		X			X	X
Demarest Lloyd Memorial State Park		X			X	X
Horseneck Beach State Park		X				X
Freetown-Fall River State Forest		X		X		X
Fall River Wildlife Management Area		X		X		X
Dighton Rock State Park		X				X
Massasoit State Park		X				X
Watson Pond State Park		X				X
<u>RHODE ISLAND</u>						
Sapowet Management Area		X		X		X
Ten Mile River State Park		X				X
Lincoln Woods State Park		X				X
Dyerville State Park		X				X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>RHODE ISLAND (cont'd)</u>						
Squantum Woods State Park		X				X
J.L. Curran Park		X				X
Meshticut State Park		X				X
E.J. Fay Field		X				X
Haines Memorial State Park		X			X	X
Colt State Park		X			X	X
Prudence Island Management Area		X		X		
Goddard Memorial State Park		X			X	X
Cocomussoc State Park		X				X
Hope Island Management Area		X		X		
Gould Island Management Area		X		X		
Marsh Meadows Wildlife Reserve		X		X		
Dutch Island Management Area		X		X		
Fort Wetherill State Park		X			X	
Norman Sanctuary			X	X		
Sachuest Point National Wildlife Refuge	X			X		
Fort Adams State Park		X			X	
Brenton Point State Park		X				X
Scarborough State Beach		X				X
Galilee Bird Sanctuary		X		X		
Fishermans Memorial State Park		X				X
Roger W. Wheeler Memorial Beach		X				X
East Matunuck State Beach		X				X
Great Swamp Management Area		X		X		

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>RHODE ISLAND (cont'd)</u>						
South Shore Management Area		X		X		
Trustum Pond National Wildlife Refuge	X			X		
Block Island National Wildlife Refuge	X			X		
Block Island State Beach		X				X
Ninigret Conservation Area		X		X		
Ninigret National Wildlife Refuge	X			X		
Kimball Bird Sanctuary			X	X		
Burlingame State Park		X		X		X
Burlingame Management Area		X		X		
Indian Cedar Swamp Management Area		X		X		
Carolina Management Area		X		X		
Woody Hill Management Area		X		X		
<u>CONNECTICUT</u>						
Pachaug State Forest		X		X		X
Assekong Swamp State Forest		X		X		X
Bluff Point State Park		X				X
Fort Griswold State Park		X			X	
Stoddard Hill State Park		X				X
Fort Shantok State Park		X			X	
Harkness Memorial State Park		X			X	
Rocky Neck State Park		X				X
Nehantic State Forest		X		X		X
Dart Island State Park		X				X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>CONNECTICUT (cont'd)</u>						
Hurd State Park		X				X
George D. Seymour State Park		X				X
Haddam Island State Park		X				X
Haddam Meadow State Park		X				X
Brainard Homestead State Park		X			X	
Gillette Castle State Park		X			X	
Selden Neck State Park		X				X
Salt Meadow National Wildlife Refuge	X			X		X
Cockaponset State Forest		X		X		X
Chatfield Hollow State Park		X				X
Hammonasset Beach State Park		X				X
Trimountain State Park		X				X
Wharton Brook State Park		X				X
Quinipiac River State Park		X				X
Sleeping Giant State Park		X				X
Naugatuck State Forest		X		X		X
Silver Sands State Park		X				X
Osbornedale State Park		X				X
Sherwood Island State Park		X				X
<u>NEW YORK</u>						
Planting Fields Arboretum State Park		X				X
Oyster Bay National Wildlife Refuge	X			X		
Caumsett State Park		X				X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NEW YORK (cont'd)</u>						
Target Rock National Wildlife Refuge	X			X		X
Sunken Meadow State Park		X				X
Nissequogue River State Park		X				X
Brookhaven State Park		X				X
Wildwood State Park		X				X
Conscience Point National Wildlife Refuge	X			X		
Elizabeth Alexandra Morton National Wildlife Refuge	X			X		
Orient Beach State Park		X				X
Hither Hills State Park		X				X
Montauk Point State Park		X				X
Amagansett National Wildlife Refuge	X			X		X
Fire Island National Seashore	X			X		
Wertheim National Wildlife Refuge	X			X		
Smith Point County Park			X			X
Connetquot River State Park		X				X
Bayard Cutting Arboretum State Park		X				X
Heckscher State Park		X				X
Seatuck National Wildlife Refuge	X		X			
Robert Moses State Park		X				X
Captree State Park		X				X
Gilgo State Park		X				X
Belmont Lake State Park		X				X
Bethpage State Park		X				X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NEW YORK (cont'd)</u>						
Massapequa State Park		X				X
Jones Beach State Park		X				X
Hempstead Lake State Park		X				X
Valley Stream State Park		X				X
Jamaica Bay Wildlife Refuge	X			X		
Martin Van Buren National Historic Site	X				X	
Bristol Beach State Park		X				X
Clermont State Park		X				X
Mills Memorial State Park		X			X	X
Margaret Lewis Norrie State Park		X				X
Vanderbilt Mansion National Historic Site	X				X	
Franklin Delano Roosevelt Home National Historic Site	X				X	
Hudson Highlands State Park		X				X
Bear Mountain State Park		X				X
Harriman State Park		X				X
Stony Point State Park		X				X
Haverstraw Beach State Park		X				X
Rockland Lake State Park		X				X
Hook Mountain State Park		X				X
Nyack Beach State Park		X				X
Tallman Mountain State Park		X				X
Statue of Liberty National Monument	X				X	

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NEW YORK-NEW JERSEY</u>						
Gateway National Recreation Area	X			X	X	X
<u>NEW JERSEY</u>						
Palisades State Park		X				X
Cheesequake State Park		X				X
Allaire State Park		X				X
Manasquan Fish and Wildlife Management Area		X		X		X
Butterfly Pond Fish and Wildlife Management Area		X		X		X
Colliers Mills Fish and Wildlife Management Area		X		X		X
Manchester Fish and Wildlife Management Area		X		X		X
Whitings Fish and Wildlife Management Area		X		X		X
Forked River Game Farm		X				X
Island Beach State Park		X				X
Barnegat Lighthouse State Park		X			X	X
Barnegat National Wildlife Refuge	X			X		
Manahawkin Fish and Wildlife Management Area		X		X		X
Stafford Forge Fish and Wildlife Management Area		X		X		X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NEW JERSEY (cont'd)</u>						
Bass River State Forest		X		X		X
Penn State Forest		X		X		X
Wharton State Forest		X		X		X
Green Bank State Forest		X		X		X
Swan Bay Fish and Wildlife Management Area		X		X		X
Port Republic Fish and Wildlife Management Area		X		X		X
Great Bay Fish and Wildlife Management Area		X		X		X
Brigantine National Wildlife Refuge/ Brigantine Wilderness*	X			X		
Absecon Coastal Wetlands		X		X		
Tuckahoe-Corbin City Fish and Wildlife Management Area		X		X		X
Peaslee Fish and Wildlife Management Area		X		X		X
Marmora Coastal Wetlands		X		X		X
Cape May Point State Park		X		X		X
Higbee Beach-Pond Creek Wildlife Management Area		X		X		X

\* Class I air quality area.

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NEW JERSEY (cont'd)</u>						
Beaver Swamp Fish and Wildlife Management Area		X		X		X
Dennis Creek Fish and Wildlife Management Area		X		X		X
Belleplain State Forest		X		X		X
Menantico Ponds Fish and Wildlife Management Area		X		X		X
Heislerville Fish and Wildlife Management Area		X		X		X
Edward G. Bevan Fish and Wildlife Management Area		X		X		X
Egg Island Fish and Wildlife Management Area		X		X		X
Fortescue Fish and Wildlife Management Area		X		X		X
Nantuxent Fish and Wildlife Management Area		X		X		X
Clarks Pond Fish and Wildlife Management Area		X		X		X
Dix Fish and Wildlife Management Area		X		X		X
Mad Horse Creek Fish and Wildlife Management Area		X		X		X
Maskell's Mill Fish and Wildlife Management Area		X		X		X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NEW JERSEY (cont'd)</u>						
Supawna Meadows National Wildlife Refuge	X			X		
Fort Mott State Park		X			X	
<u>PENNSYLVANIA</u>						
Tinicum National Environmental Center	X			X		
<u>DELAWARE</u>						
Brandywine Creek State Park		X				X
Brandywine Springs State Park		X				X
Walter S. Carpenter State Park		X				X
Fort Delaware State Park		X			X	
Lums Pond State Park		X				X
Augustine Wildlife Area		X		X		X
Appoquinimink Wildlife Area		X		X		X
Blackbird State Forest		X		X		X
Blackiston Wildlife Area		X		X		X
Woodland Beach Wildlife Area		X		X		X
Bombay Hook National Wildlife Refuge	X			X		
Little Creek Wildlife Area				X		
Norman G. Wilder Conservation Area		X		X		X
Killen Pond State Park		X		X		X
Milford Neck Wildlife Area		X		X		X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>DELAWARE (cont'd)</u>						
Prime Hook National Wildlife Refuge	X			X		X
State Wildlife Area		X		X		X
State Forest Owens Tract		X		X		X
Ellendale State Forest		X		X		X
Redden State Forest		X		X		X
Cape Henlopen State Park		X				X
Gordon Pond Wildlife Area		X		X		X
Delaware Seashore State Park		X		X		X
Nanticoke Wildlife Area		X				X
Trap Pond State Park		X				X
Assawoman Wildlife Area		X		X		X
<u>DELAWARE-MARYLAND</u>						
Chesapeake and Delaware Canal Wildlife Area	X			X		
<u>MARYLAND</u>						
Wicomico State Forest		X		X		X
Johnson Wildlife Management Area		X		X		X
Pocomoke State Forest		X		X		X
Sinepuxent Bay Wildlife Management Area		X		X		X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>MARYLAND (cont'd)</u>						
Assateague State Park		X				X
Pocomoke River Wildlife Management Area		X		X		X
E.A. Vaughn Wildlife Management Area		X		X		X
Pocomoke Sound Wildlife Management Area		X		X		X
Cedar Island Wildlife Management Area		X		X		X
Martin National Wildlife Refuge	X			X		
Janes Island State Park		X				X
Fairmount Wildlife Management Area		X		X		X
Wellington Wildlife Management Area		X		X		X
Deal Island Wildlife Management Area		X		X		X
Ellis Bay Wildlife Management Area		X		X		X
Fishing Bay Wildlife Management Area		X		X		X
Blackwater National Wildlife Refuge	X			X		
Taylors Island Wildlife Management Area		X		X		X
Lecompte Wildlife Management Area		X		X		X
Linkwood Wildlife Management Area		X		X		X
Idylwild Wildlife Management Area		X		X		X
Seth State Forest		X		X		X
Martinak State Park		X				X
Tuckahoe State Park		X				X
Mill Creek Wildlife Sanctuary		X		X		

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>MARYLAND (cont'd)</u>						
Wye Oak State Park		X				X
Matapeake State Park		X				X
Eastern Neck National Wildlife Refuge	X			X		
Remington Farms Wildlife Reserve		X		X		
Millington Wildlife Management Area		X		X		X
Elk Neck State Park		X				X
Elk Neck State Forest		X		X		X
Susquehanna National Wildlife Refuge	X			X		
Susquehanna State Park		X				X
Rocks State Park		X				X
Gunpowder Falls State Park		X				X
Gwynnbrook Wildlife Management Area		X		X		X
Soldiers Delight Natural Environment Area		X		X		X
Patapsco Valley State Park		X				X
Fort McHenry National Monument and Historic Shrine	X				X	
Severn Run Natural Environment Area		X		X		X
Sandy Point State Park		X				X
Jonas Green State Park		X				X
Patuxent Wildlife Research Center	X			X		
Rosaryville State Park		X				X
Merkle Wildlife Management Area		X		X		X
Bowen Wildlife Management Area		X		X		X

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>MARYLAND (cont'd)</u>						
Calvert Cliffs State Park		X				X
Chancellor's Point Wildlife Preserve		X		X		
Point Lookout State Park		X				X
Cedarville Natural Resource Management Area		X		X		X
Doncaster State Forest		X		X		X
Smallwood State Park		X				X
Myrtle Grove Wildlife Management Area		X		X		X
Piscataway Park	X					X
Fort Washington National Park	X				X	
<u>MARYLAND-VIRGINIA</u>						
Assateague Island National Seashore	X			X		
Chincoteague National Wildlife Refuge	X			X		
<u>VIRGINIA</u>						
Wallops Island National Wildlife Refuge	X			X		
Metomkin Island Nature Conservancy			X	X		
Cedar Island Nature Conservancy Refuge			X	X		

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>VIRGINIA (cont'd)</u>						
Parramore Island Nature Conservancy						
Revel Island Nature Conservancy Refuge			X	X		
Sandy Island Nature Conservancy Refuge			X	X		
Hog Island Nature Conservancy Refuge			X	X		
Rogue Island Nature Conservancy Refuge			X	X		
Cobb Island Nature Conservancy Refuge			X	X		
Godwin Island Nature Conservancy Refuge			X	X		
Wreck Island Natural Area Nature Conservancy Refuge			X	X		
Mockhorn Island Waterfowl Management Area		X		X		X
Ship Shoal Island Nature Conservancy Refuge			X	X		
Mink Island Nature Conservancy Refuge			X	X		
Myrtle Island Nature Conservancy Refuge			X	X		
Smith Island Nature Conservancy Refuge			X	X		
Fisherman Island National Wildlife Refuge	X			X		
Parkers Marsh Natural Area		X		X		
Saxis Marsh Waterfowl Management Area		X		X		X
George Washington Memorial Parkway	X					X
Grist Mill Historic Park		X			X	
Mason Neck National Wildlife Refuge	X			X		
Marumsc National Wildlife Refuge	X			X		

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>VIRGINIA (cont'd)</u>						
Featherstone National Wildlife Refuge	X			X		
Manassas National Battlefield Park	X				X	
Conway-Robinson State Forest		X		X		X
Prince William Forest Park	X					X
Quantico Marine Base Wildlife Management Area	X			X		X
Fredericksburg and Spotsylvania National Military Park	X				X	
Lands End Wildlife Management Refuge		X		X		X
George Washington Birthplace National Monument	X				X	
Westmoreland State Park		X				X
State Forest Research Farm		X		X		
Richmond National Battlefield Park	X				X	
Chickahominy Wildlife Management Area		X		X		X
State Forest Nursery		X		X		
York River State Park		X				X
Colonial National Historical Park	X				X	
Jamestown National Historic Site	X				X	
Plum Tree Island National Wildlife Refuge	X					
Pocahontas State Forest		X		X		X
Pocahontas State Park		X		X		X
Presquille National Wildlife Refuge	X			X		

continued

Table 8 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>VIRGINIA (cont'd)</u>						
Petersburg National Battlefield	X				X	
Charles C. Steirly Heron Rookery		X		X		X
Chippokes Plantation State Park		X		X		X
Hog Island Wildlife Management Area		X		X		X
Ragged Island Wildlife Management Area		X		X		
Nansemond National Wildlife Refuge	X			X		
Seashore State Park and Natural Area		X		X		X

concluded

Table 9. Species with special status in the Middle Atlantic Zone.

Map No.	Species	Federal		State	
		Endangered	Threatened	Endangered	Threatened
<u>FISH</u>					
110	Shortnose sturgeon	X			
111	Atlantic sturgeon			VA	NJ
116	American shad				NJ
200	Maryland darter	X			
<u>AQUATIC REPTILES AND AMPHIBIANS</u>					
201	Green sea turtle		X		
202	Loggerhead sea turtle		X		
203	Hawksbill turtle	X			
204	Atlantic ridley turtle	X			
205	Leatherback turtle	X			
<u>MARINE MAMMALS</u>					
257	Right whale	X			
	Sei whale	X			
	Humpback whale	X			
	Blue whale	X			
	Fin whale	X			
	Sperm whale	X			
<u>PLANTS</u>					
308	Prickly pear cactus*				
309	Trailing arbutus*				
318	Ebony spleenwort*				
319	Orchids*				
320	Golden club*				

\* Species is legally protected in New York, but has not been specifically designated as a threatened or endangered species.

continued

Table 9 (continued).

Map No.	Species	Federal		State	
		Endangered	Threatened	Endangered	Threatened
<u>BIRDS</u>					
406	Least tern			NJ	
407	Roseate tern				NJ
412	Black skimmer			NJ	
437	Great blue heron				NJ
441	Yellow-crowned night heron				NJ
505	Bald eagle	X			
506	Osprey			NY, NJ	
507	Peregrine falcon	X			
508	Cooper's hawk			NJ	
510	Marsh hawk			NJ	
<u>TERRESTRIAL REPTILES AND AMPHIBIANS</u>					
607	Bog turtle			NY, NJ, MD	
609	Eastern tiger salamander			NJ, MD	
621	Pine barrens tree frog			NJ	
622	Northern pine snake				NJ
623	Corn snake				NJ
624	Timber rattlesnake			NJ	
625	Southern gray tree frog				
<u>TERRESTRIAL MAMMALS</u>					
722	Delmarva fox squirrel	X			

concluded

The shortnose sturgeon (110) is an anadromous species which ranges from Cape Cod to Florida and overwinters in coastal marine waters or in deep high-salinity portions of estuaries. Once abundant in inland waters and coastal streams, sturgeon is now scarce everywhere. During the early spring, the shortnose sturgeon migrates upstream to low-salinity areas where it spawns near the fresh-water and brackish water interface. The development patterns of the larval and juvenile sturgeon are unknown.

The Maryland darter (200), a Federally endangered fish species, is found in only two creeks in Maryland: Deer Creek (grid reference UU98) and Swan Creek (grid reference VU07).

Several species of sea turtles frequent the Middle Atlantic Zone during their northward summer migration. The loggerhead turtle (202) nests along the sandy ocean beaches in the southern portion of the zone. This species also is believed to be extending its nesting range northward to Long Island. Adult green sea (201) and leatherback (205) turtles are found occasionally in shallow bay waters, but only immature Atlantic ridley turtles (204) are reported in mid-Atlantic coastal waters. The hawksbill turtle (203) rarely is observed in the Middle Atlantic Zone.

Six whale species of special status infrequently are reported in mid-Atlantic waters during their migrations between wintering and summering areas. The humpback, right, and fin whales are common coastal migrants while the sei, blue, and sperm whales usually occur far offshore in deep water. The fin whale, the most common baleen whale observed, tends to concentrate along the Atlantic coast during the winter.

Bald eagles (505) are permanent residents in the Middle Atlantic Zone and also migrate through the area. Migrant eagles may overwinter or nest in the southern portions of this zone, but after breeding, they return in the summer to northern coastal states or to Canada. Most eagle nests are built in tall trees adjacent to marshes or tidal rivers.

The peregrine falcon (507) is an endangered species which migrates along the entire coastal region. The peregrine falcon no longer breeds in the Middle Atlantic Zone due to the effects of pollution, but a management program is underway whereby falcons reared in captivity are released in the Middle Atlantic Zone to reestablish a breeding population. Peregrine falcon migration begins in mid-September and peaks in October; some migrants only remain for short periods while a few overwinter in the zone.

Although the osprey is not listed as an endangered species for the Middle Atlantic Zone, it is considered to be a species of concern. Previously abundant, during the last 20 to 30 years the number of osprey has substantially declined. A major southward movement of ospreys occurs along the coast in fall; in spring, the birds return to their nests in northern marshes and along rivers and bays.

The Delmarva fox squirrel (722) presently exists only in portions of the Delmarva Peninsula, where it prefers small woodlots which contain large trees and sparse understory.

### 5.2.2 Aquatic Resources

The aquatic organisms in the Middle Atlantic Zone are both abundant and diverse due to the extensive and highly productive estuaries and marshes. Brief descriptions of the life histories of the major commercially, recreationally, and ecologically important aquatic organisms which occur in the Middle Atlantic Zone are provided below. This summary discusses those species which were not covered previously in the Resources Overview of the North Atlantic Zone (see part 4.2).

#### Invertebrates

Oysters, clams, and bay scallops are permanent residents of estuaries and form a major component of the Middle Atlantic Zone fishery. The eastern oyster is the most valuable shellfish in the Middle Atlantic Zone, and the Chesapeake Bay contributes a large portion of the commercial harvest. Oysters prefer salinities between 5 and 15 parts per thousand and water depths of from 2 to 8 meters (8 to 25 feet). Their abundance in high-salinity areas is limited by predatory oyster drills and protozoan parasites. Oysters spawn during the summer, and the eggs hatch after 6 to 14 days; the free-swimming larvae settle where they can attach to a suitable hard substrate, such as old oysterbeds. They reach marketable size within 3 to 5 years, depending on latitude, and are harvested in the fall and winter.

The hard clam, or quahog, is another major commercial mollusk species, especially in New York. It is found in waters of greater than 15 parts per thousand salinity in sandy and shelly substrate. Hard clams spawn in the summer, and after 1 to 2 weeks the planktonic larvae settle mainly in shallows and eelgrass and develop into sessile adults. They reach commercial size within 2 to 3 years and may be harvested throughout the year, but mainly during the summer.

The soft shell clam is distributed widely in estuaries with sandy mud substrate in less than 6-meter (20-foot) depths. Spawning occurs in the late summer, and after a 2-week planktonic stage, the juveniles attach to sand grains. The soft shell clam grows to commercial size in approximately 2 years. The species is harvested throughout the year, although most harvesting occurs in the summer.

The bay scallop is found in shallows and eelgrass beds. It spawns in the early summer and the planktonic larvae settle in approximately 10 days. Adults can be harvested within 1 year. Harvesting usually begins after the spawning season and continues through the summer and fall until the adult stock is depleted.

Another sessile species, the surf clam, is found in nearshore coastal waters. Unlike other bivalves, the commercially important surf clam is restricted to ocean waters generally of less than 46 meters (150 feet); it generally is more abundant in coarse sediment. This species spawns in the summer and fall and reaches commercial size in 5 to 6 years. Surf clams are harvested throughout the year and provide approximately 60 percent of all clam meat used in the United States.

The blue crab, a common inhabitant of estuarine and coastal waters of the Middle Atlantic Zone, supports a substantial recreational fishery and the largest commercial crabbing industry in the United States. The harvest is mainly from spring to fall.

The life history of the blue crab is completed in waters of varying salinity; male crabs prefer lower salinities than do the females. Blue crabs migrate to low-salinity waters in the spring and mate in late spring to early fall when the female is in the soft crab stage of molt. Gravid females migrate to high-salinity waters, generally at the mouths of major estuaries, to hatch their young. The crab larvae and juveniles move inshore to the low-salinity waters of estuaries to feed and mature. Seasonal hibernation by subadult and adult crabs occurs in offshore waters or at the mouths of major estuaries such as the Chesapeake Bay.

### Fish

a. Anadromous species. Anadromous species, such as American shad, alewife, blueback herring, white perch, striped bass, and Atlantic sturgeon, migrate from the ocean through the estuaries to spawn in brackish or freshwater rivers. The juveniles of these species use the estuaries of the Middle Atlantic Zone as nursery areas.

The American shad, alewife, and blueback herring are important sport, commercial, and forage species. These fish migrate throughout the zone during the spring, but the migrations are more prolonged and occur later in the season at higher latitudes. The American shad is the first of these fish to appear in coastal waters; it returns to its hatching area in the beginning of March and spawns during the spring in tidal freshwaters along the shallow flats of mainstem rivers. Adults leave the rivers and estuaries by early summer, but the young remain in the low-salinity nursery ground and gradually move downstream until late fall when they move out to sea. The alewife is next to appear, migrating up the estuary to small freshwater streams to spawn during the spring. Adults return to the lower estuary during the summer and leave by late summer. The juveniles swim downstream slowly through the estuarine nursery areas until they migrate out to sea in the fall. The blueback herring is the last to appear, spawning in tidal freshwater and brackish water tributaries over clean, swept sand and gravel beginning in April. The remainder of the blueback herring's life cycle is similar to the alewife's life cycle. These herring species are recreationally and commercially fished when they migrate in the spring.

Some or all of the adult populations of white perch and striped bass live within the saline portions of an estuary, but the entire population migrates to freshwater to spawn. The white perch is found mainly in estuaries; some discrete populations inhabit particular tributaries. In March, perch migrate from their winter grounds in deep portions of estuaries to tidal freshwater tributaries, where they spawn in the shallows throughout the spring. After spawning, the adult perch scatter throughout the rivers and bays while the juveniles mature in the low-salinity nursery areas. During the summer, they collectively move downstream to their wintering grounds.

The striped bass is found mainly in the ocean during its nonspawning seasons, although large indigenous populations are located in the Hudson River and

Chesapeake Bay. The migration and spawning of the striped bass are similar to the migration and spawning of the white perch, but spawning is restricted to only a few tidal freshwater rivers. During summer, adults disperse to feed in estuarine waters; juveniles remain in nursery grounds characterized by less than 6 parts per thousand salinity. As the young mature, they gradually move downstream. Fishing for striped bass occurs mainly in the spring and fall in temperate coastal and estuarine waters.

The abundance of Atlantic sturgeon has declined in recent years. This species, once commercially important and abundant at the turn of the century, is presently classified as endangered in Virginia and threatened in New Jersey. In other states, sturgeon is fished commercially during its spring and fall migrations. Atlantic sturgeon migrates from ocean and deep river overwintering grounds in April and May to spawn at the brackish water and freshwater interface. The juvenile sturgeon is believed to spend a number of years in the estuaries before migrating to the ocean in the summer and fall with the adults.

b. Catadromous species. The American eel is widely distributed throughout the mid-Atlantic estuaries. The adults migrate from the rivers and estuaries in the late summer and fall to spawn, presumably in the Sargasso Sea during the winter, and then die. After hatching, larvae move in the direction of the North American continent. Juveniles arrive in the estuaries in mid-spring to grow and mature for several years. Eels are active throughout the shallows, primarily during the night. During the winter, eels are believed to move downstream to deep water. The eel catch is taken from March to December, but the catch is most productive in the fall.

c. Estuarine-dependent species. Many species are estuarine-dependent, that is, some stage of their life history is spent within an estuary. Estuarine-dependent species make up the majority of the ecologically, recreationally, and commercially important fisheries within the Middle Atlantic Zone. Species such as the Atlantic menhaden, weakfish, spot, Atlantic croaker, northern kingfish, silver perch, bluefish, and summer and winter flounder use the estuaries extensively as spawning, nursery, or feeding grounds, but they also are found as adults along the Continental Shelf.

The drum family is the major estuarine-dependent fish group in the Middle Atlantic Zone, with major representatives being the weakfish, spot, and Atlantic croaker.

Weakfish, the most widely distributed drum in the Middle Atlantic Zone, spawns in the more saline portions of estuaries and in coastal waters during the late spring and summer. The young move upstream to low-salinity nursery grounds in the shallows, marshes, and seagrass beds.

Spot is found mainly in the southern portion of the Middle Atlantic Zone. It spawns offshore during the late fall and winter; in early spring, the juveniles move to low-salinity estuarine nursery grounds in shallows, marshes, and seagrass beds. The adults are distributed widely in the Chesapeake Bay and Delmarva Shore estuaries from early summer to fall.

Atlantic croaker occurs mainly from New Jersey southward. Adults spawn offshore from August through December and migrate into the bays in early spring,

although not as far upstream as spot. In mid-summer and early fall the adults return to the offshore spawning grounds. The young enter the shallows or marshes of estuaries from late summer to early winter.

Weakfish, spot, and Atlantic croaker support an important commercial and recreational fishery from the spring through the fall; best yields for spot and weakfish occur in the late summer and fall, and the best yield for the croaker is in the spring. Major fishing areas tend to be in the high-salinity portions of the bays and in coastal waters.

The menhaden is the most valuable finfish in the Middle Atlantic Zone and has the highest commercial yield of any finfish or shellfish. This species spawns in the ocean during the winter; the prejuveniles enter the estuaries in the beginning of March, and they remain there throughout the summer. Juveniles initially inhabit low-salinity nursery areas, but move slowly downstream to the high-salinity portions of the estuary as they develop. Adults stay in the high-salinity bays most of the summer, and emigrate to the sea in October with the juveniles. The important menhaden fishery extends mainly from March through December.

Bluefish is found predominantly in ocean waters throughout most of the year. After being spawned in the ocean during the summer, the juveniles enter into all portions of the estuaries where the mature. The adults also move inshore during the summer, although they are not found in as low salinities as the juveniles. Bluefish is of first importance as a recreational fishery and of second importance as a major commercial species. The largest bluefish catches generally occur in the late summer and early fall.

Summer and winter flounder also are recreationally and commercially important estuarine-dependent species. Adult summer flounder overwinters and spawns offshore. Adults and juveniles spawned in the fall move inshore during the spring, with the juveniles moving inshore mainly in the southern portion of the zone; both adults and juveniles return offshore in the late summer and fall. The summer flounder is fished throughout the year. The recreational fishery for this species occurs inshore during spring to fall, and the offshore commercial fishery occurs during winter and early spring. The winter flounder, however, moves inshore during the fall, overwinters in the bays, and spawns in the shallows during January through March. As the water warms in the spring, the adults migrate to deeper estuarine or nearshore waters where they summer, while the juveniles remain in the estuaries.

Cunner is an important sport species found on hard substrate and near wharves or ledges to depths of 73 meters (240 feet). The cunner overwinters in deeper waters and moves inshore during the spring and summer to spawn.

d. Oceanic species. Several offshore species occasionally occur in lower estuaries, but are more often found in coastal waters where they use estuarine-dependent species as food. These species, which include scup, black sea bass, and Atlantic mackerel, are of recreational and commercial importance. These oceanic species move nearshore in the late spring and summer. The scup inhabits nearshore waters from April to October during which time it spawns. In the fall and winter, it moves offshore and to the south. The major commercial fishery occurs in the fall through early spring when the adults are concentrated in

offshore wintering grounds. An active sport fishery and some commercial activity occur in the nearshore summering grounds. The black sea bass has a life history similar to the scup, moving nearshore and spawning in the spring and summer and moving offshore and southward in the winter. The Atlantic mackerel spawns in the spring and early summer over most of the mid-Atlantic Continental Shelf. It is found in nearshore waters from late spring through late fall, concentrating in areas north of the Delaware Bay.

Tautog is a sport fish normally found inshore to depths of 18 meters (60 feet). It is a groundfish which occurs over hard bottoms and near wrecks and jetties. Tautog overwinters in deeper waters and moves inshore during the spring and summer for spawning.

For more extensive information, the reader should refer to the Development of Fishes of the Mid-Atlantic Bight (U.S. Department of Interior, 1978) and to the Coastal and Offshore Environmental Inventory, Cape Hatteras to Nantucket Shoals (University of Rhode Island, Marine Experiment Station, 1973). Information on the commercial harvest and value of aquatic species is summarized in Current Fisheries Statistics, which is published by the Department of Commerce, National Marine Fisheries Service.

### Mammals

Marine mammals are not abundant in the Middle Atlantic Zone, and most of these species inhabit the offshore waters instead of the nearshore waters. Information on marine mammals is limited to occasional sightings and strandings.

### 5.2.3 Terrestrial Resources

Although much of the Middle Atlantic Zone is urbanized, open stretches of the coast are characterized by sandy beaches or narrow barrier islands vegetated with dunegrass, shrubs, and sometimes hardwoods. Inland portions of the coastal zone, however, contain oak-pine forests interspersed with farmlands, pastures, developments, and wetlands. Marshes usually occur on the landward side of barrier islands around many of the bays and along the tidal portion of most rivers. Salt marshes, with large areas of cordgrass, salt hay, and rushes, are the most abundant, although freshwater and brackish marshes are common locally. Marshes, undeveloped shorelines, bays, rivers, and forests constitute some of the more valuable wildlife areas in the zone and provide breeding and concentration grounds for colonial nesting birds, waterfowl, and furbearers.

Many wildlife refuges (table 8) have been established to serve as important sanctuaries in the coastal zone. These refuges are vital to the protection and long-term maintenance of the Atlantic region's avifauna and provide important habitats for other wildlife species, including amphibians, reptiles, and furbearing animals, many of which are permanent residents of the zone.

### Birds

The deeply indented coastline of the Middle Atlantic Zone with its numerous rivers, bays, and estuaries profoundly influences the migratory patterns of birds. The primary migratory route for birds in the Middle Atlantic Zone is the Atlantic flyway, which consists of several small corridors such as the Atlantic

shoreline, Hudson River, Delaware Bay, Chesapeake Bay, and Potomac River flyways. The Atlantic flyway is used by large numbers of waterfowl, shorebirds, and landbirds as they migrate through or overwinter in the coastal marshes, bays, rivers, and ponds within this zone. Several coastal localities and refuges are important concentration points for birds in their north-south migrations.

About 380 species of birds have been reported to frequent the coastal lands and offshore waters of the Middle Atlantic Zone.

a. Shorebirds. Shorebirds of the Middle Atlantic Zone include plovers, oystercatchers, gulls, terns, and skimmers. Shorebirds generally occur in beach areas, but also are common in marshes and mudflats; gulls and terns frequently breed on dredge spoil banks because the banks are more remote than their historical breeding grounds. Increased beachfront development and recreational use have contributed to the loss of suitable nesting sites for several of the nesting beach birds, such as black skimmers and least terns. Nevertheless, over 130,000 breeding pairs of the most common shorebirds are estimated to reproduce in this zone during the warmer months. The most abundant shorebirds, in terms of pair estimates, which breed in major portions of this zone include the herring gull (28,000 pairs), common tern (20,000 pairs), and least tern (5,000 pairs). Other species of shorebirds breed in the Middle Atlantic Zone in colonies in limited localities; these species are discussed only for specific sections of the zone. Although shorebirds are migratory, many northern species also overwinter in the zone. Flocks migrate north from early May to the beginning of June, and south from early August to early October.

b. Wading birds. Wading birds, particularly herons, egrets, and ibises, are among the most conspicuous birds in this zone. They are prolific breeders and are widespread throughout the Middle Atlantic Zone; furthermore, they are expanding their range. Wading birds were at one time nearly extirpated by plume hunters and egg collectors. These species usually nest colonially in marshes, or more often, in shrubs and trees on coastal islands and on the mainland. Some colonies contain thousands of breeding pairs of many different species, while other colonies have a few dozen pairs of a single species. Estimates indicate that over 30,000 breeding pairs of the most common species nest in this zone. The most abundant wading birds, in terms of pair estimates, nesting in this zone are the snowy egret (9,000 pairs), black-crowned night heron (6,000 pairs), glossy ibis (5,000 pairs), and great egret (2,000 pairs). These and other species arrive about mid-March and nest from early May to mid-July. In the fall they begin their migration to winter in the south.

Other birds which are common breeding residents of the coastal marshes throughout the Middle Atlantic Zone are the American coot, common gallinule, clapper rail, Virginia rail, sora rail, and king rail. The king rail and gallinule are freshwater species. Sora rails and coots prefer freshwater marshes for nesting; however, they frequently use brackish and salt marshes during migration. The other rails breed in salt marshes.

c. Waterfowl. Approximately, 30 species of waterfowl are found in the Middle Atlantic Zone. Waterfowl areas shown on the accompanying inventory maps represent the most important concentration areas within the zone. In the Chesapeake Bay region, for example, specific areas shown to be inhabited by dabbling

ducks, diving ducks, geese, and swans are those which consistently harbor over 1,000 individuals.

Waterfowl, such as dabbling and diving ducks and geese, seasonally frequent the zone on their annual migratory flights along the Atlantic flyway. Representative dabbling ducks include mallard, pintail, American widgeon, green-winged teal, gadwall, shoveler, and black duck. Of these, mallard and black duck are the most abundant. Lesser scaup, redhead, canvasback, and ring-necked ducks are the most common diving ducks. The Canada goose far outnumbers other geese, with the snow goose and brant being next in importance. Large numbers of whistling swans also use this zone for migrations and wintering.

Dabbling ducks and Canada geese prefer the freshwater or brackish water areas of the coastal region while diving ducks, including mergansers, brants, loons, grebes, and cormorants, use the salt marshes, open waters, and nearshore areas extensively. Wood ducks are rare visitors to coastal areas; however, they commonly breed in inland swamps and along forested streams throughout the Middle Atlantic Zone. By early May, Canada goose goslings have hatched, and during June and early July, broods of other waterfowl hatch.

The peak of the fall migration for waterfowl is during October and November, when the waterfowl fly from their northern breeding grounds to their southern wintering areas. In spring, flights occur from March to early May as the birds return north. In particular, brants and snow geese follow the ocean coast.

The wintering migratory waterfowl population in the Middle Atlantic Zone (table 10) fluctuates markedly from year to year in response to many factors, including habitat conditions, productivity, and harvest pressures. Many of the waterfowl which overwinter in the zone have traveled a thousand miles or more.

Annually, over 1 million ducks and thousands of geese are harvested by hunters in the Middle Atlantic Zone. Migratory waterfowl, such as canvasbacks, mallards, wood ducks, and Canada geese, are particularly sought by hunters. Mallards appear to be the most hunted species. Hunting mortality causes a temporary 15- to 25-percent reduction in the total waterfowl population. The waterfowl population usually is restored during the next breeding season. Hunting pressures tend to concentrate waterfowl in large bodies of water, refuges, or other inaccessible areas which generally are closed to recreational activities or hunting.

d. Raptors. Many hawks and owls breed, migrate through, or winter in the Middle Atlantic Zone. Owls generally occur inland while hawks prefer coastal areas, marshes, and bays. Hawks generally follow low ridges and the coast during their migrations.

e. Seabirds. Seabirds do not commonly nest in the Middle Atlantic Zone, although they are known to winter offshore, usually beyond the three-mile limit. Occasionally, some seabirds, such as alcids, gannets, storm petrels, and shearwaters will fly or rest close to shore for short periods of time.

f. Songbirds and others. Numerous bird species breed, migrate through, or winter in the Middle Atlantic Zone. These birds occupy many types of habitats: farmlands, woodlands, wetlands, suburban areas, and even high-rise buildings in

Table 10. Minimum wintering populations of migratory waterfowl  
in the Middle Atlantic Zone (Massachusetts through North Carolina).

Species	1969	1970	1971	1972	1973	1974	1975	1976	1977
Mallard	106,500	83,200	75,400	74,700	90,400	102,500	77,485	106,144	154,850
Black duck	271,600	224,300	201,300	216,900	225,700	200,400	189,513	231,987	227,390
Gadwall	2,800	3,100	1,700	3,300	4,300	10,800	10,442	17,660	27,005
Widgeon	52,400	22,900	29,300	30,400	26,000	35,400	48,035	59,633	41,154
Teal	11,100	9,100	35,200	26,700	12,200	27,100	24,745	24,460	14,946
Pintail	69,300	47,200	44,800	30,800	28,000	49,900	40,219	67,507	63,875
Redhead	23,300	35,400	29,800	20,000	27,700	14,100	19,085	41,050	76,310
Canvasback	124,700	89,800	78,900	78,900	99,700	106,200	102,630	136,936	126,135
Scaup	257,800	268,400	312,600	202,300	206,300	302,600	336,097	212,655	240,399
Goldeneye	67,300	37,300	45,400	46,000	35,500	29,500	30,019	53,756	33,206
Bufflehead	44,200	51,000	24,500	40,000	37,000	52,700	39,992	59,004	64,211
Ruddy duck	39,400	36,100	50,600	28,100	41,400	46,500	54,490	18,816	42,359
Eider	45,500	54,700	24,700	44,900	28,100	62,500	46,805	45,896	40,348
Scoter	48,000	83,100	199,700	135,000	45,000	29,600	19,660	44,574	96,529
Oldsquaw	4,600	13,200	11,300	24,500	9,800	7,300	9,802	11,917	16,280
Snow goose	62,800	29,300	48,400	81,000	59,100	95,200	70,209	116,777	126,964
Canada goose	650,500	747,200	644,900	657,500	671,700	699,400	730,614	728,441	865,968
Brant	130,900	106,500	151,000	73,300	41,900	87,600	88,418	127,003	73,605
Whistling swan	62,000	55,000	58,200	62,700	56,800	63,900	154,685	78,012	76,136

SOURCE: (BLM, 1979).

coastal cities. The species diversity of landbirds as a group is great and includes flycatchers, larks, swallows, jays, crows, chickadees, titmice, nuthatches, creepers, wrens, mockingbirds, thrushes, vireos, warblers, blackbirds, finches, sparrows, and woodpeckers.

Indigenous landbirds use the Atlantic flyway as a migratory route. Breaks in the coastline of the Middle Atlantic Zone, formed by the complex series of wide estuaries and bays found there, sometimes constitute a barrier to landbirds migrating along the coast. During adverse weather conditions, birds will concentrate in large numbers at the land margins of these water bodies to wait for favorable flying conditions. Landbird migrations in the zone are the greatest from mid-April to mid-May and from late August to late October.

### Mammals

Many mammals of the Middle Atlantic Zone are recreationally and commercially valuable. Important species which are common throughout the zone, and which are hunted for sport, include the whitetail deer (the most important big game animal), eastern cottontail, gray squirrel, and eastern fox squirrel. All of these animals prefer upland areas: deer occur in immature woods and edge habitats, eastern cottontails use brushy cover, and squirrels reside in mature oak forests.

The muskrat is the most abundant of the commercially valuable furbearers in the Middle Atlantic Zone and is found in freshwater and salt marshes. The muskrat breeding season extends from January to October and several litters may be produced each year. The river otter also is commercially trapped and is widely distributed along the banks of streams and lake margins. Otters normally bear young in mid-April to early May. Mink is an important commercial species in streams and marshes. Minks mate from mid-February to early March and the young are born in April and May. Other important furbearers, common to the Middle Atlantic Zone and commercially valuable, are the raccoon, opossum, longtail weasel, striped skunk, gray fox, and red fox.

### 5.3 SOUTHERN NEW ENGLAND COAST (GRID REFERENCE DR19 TO BR55)

The northeasternmost section of the Middle Atlantic Zone extends from Monomoy Island, Massachusetts, to Montauk Point on Long Island, New York. The Southern New England Coast has been divided into two subsections: the Nantucket, Rhode Island, and Block Island Sounds, and the Long Island Sound. This section was previously glaciated; therefore, the coastline is irregular and consists of numerous large offshore islands, barrier beaches, bays, and drowned river valleys. Beaches in the Southern New England Coast section generally are sandy, but several beaches are rocky, high-energy systems. Small protected coastal marshes also are characteristic of this section. Elevations on the mainland generally are less than 60 meters (200 feet) while elevations of the offshore islands usually are less than 30 meters (100 feet). Undeveloped upland areas generally consist of deciduous forest.

This section is a transition area between the cold waters of the North Atlantic Zone and the warmer waters of the Middle Atlantic Zone. The transition occurs because the section is affected by the Labrador Current and the Gulf Stream. An offshore temperature gradient extends eastward from Monomoy Island

between the two water currents, creating a demarcation line between cold water to the north and warm water to the south. This temperature gradient exists from about mid-June to late September, and effectively separates the marine biota of the two zones. As the ocean waters cool in the fall, the temperature differences diminish. Because of the geographic orientation of the coastline in this section, the resource discussions provided below follow north-south UTM grid swaths.

#### 5.3.1 Nantucket Sound, Rhode Island Sound, and Block Island Sound (Grid Reference DR19 to BR55)

##### Aquatic Resources

The seasonal hydrographic phenomenon of these sounds has a profound influence on the finfish in this subsection. During the fall and winter, the general movement of fish is from north to south, with northern species wintering as far south as Cape Hatteras once the waters become cool and then returning to the north in the spring as the waters become warm. Warm water fish migrate to Florida and sometimes to the Gulf coast.

a. Widespread species. This subsection contains significant shellfish beds which support a large commercial fishery. Important economic species include the eastern oyster, bay scallop, surf clam, hard clam, and soft shell clam. Lobster populations in this section, near the southern limit of their range, generally are low and are not considered to be of commercial importance. In contrast, blue crabs are more numerous in this subsection than farther north, but blue crabs are not as commercially significant here as they are in the southern section of the Middle Atlantic Zone, especially in the Chesapeake Bay.

Finfish of importance in these sounds include striped bass, bluefish, tautog, cunner, scup, winter flounder, black sea bass, and bluefin tuna. Scup, black sea bass, and bluefin tuna are summer visitors while the others occur year-round. Several traditionally high-concentration areas for various species of fish are shown on the accompanying maps, but these species can be expected to inhabit the open water throughout the area.

Anadromous and freshwater fish species have been shown on the maps in representative streams. Instream species include blueback herring, alewife, American shad, Atlantic herring, brook trout, rainbow smelt, Atlantic tomcod, white and yellow perch, largemouth and smallmouth bass, and chain pickerel.

Seal crawlouts or nesting areas are important habitats throughout the section.

b. Geographic inventory. Muskeget Island (grid reference CR97) is the only gray seal rookery in the United States and occurs at the southern limit of the seal's range. Other breeding areas for this species occur much farther north in Canada.

One area of special significance in this subsection is the Atlantic salmon migration and spawning area located in the Pawcatuck River between grid references BR85 and BR65.

### Terrestrial Resources

Terrestrial and biotic resources of this subsection are protected by numerous parks and management areas.

a. Widespread species. Important bird concentration areas are scattered throughout the section and are identified below. Mammals are distributed evenly in the area, but occur in such limited numbers that their densities are not significant.

b. Geographic inventory. Between grid references DR26 and CR67 are several shorebird and wading bird nesting areas as well as waterfowl migratory areas. The most significant portion of this interval is Muskeget Island (grid reference CR97) which supports shorebirds, marsh hawks, short-eared owls, and the only known population of beach meadow voles. This species of vole has been proposed as an endangered species.

Between grid references CR56 and BR95 are other important shorebird and wading bird areas; several areas with osprey nests also are shown. A special interest area is Bird Island (grid reference CS51), which supports approximately 40 percent of the U.S. breeding population of roseate terns (900 pairs). The three largest colonies of this species represent approximately 95 percent of the breeding population.

The next interval of importance (grid reference BR85) is the Block Island area. Because of its remoteness Block Island supports a variety of terrestrial species, including wading birds, shorebirds, migrating waterfowl and songbirds, and marsh hawks. The endangered peregrine falcon is a common visitor to Block Island during its migration. This island is one of the few areas the falcon is known to use regularly. Also, the only known population of the Block Island meadow vole is found on the island. This vole also has been proposed for inclusion on the Federal endangered species list.

#### 5.3.2 Long Island Sound (Grid Reference BR55 to XA02)

This subsection encompasses the Long Island Sound and adjacent shoreline of Connecticut and New York, as well as the northern shore of Long Island. The Long Island Sound estuary is a semi-enclosed body of water measuring 145 kilometers (90 miles) long and 24 kilometers (15 miles) wide. The sound opens to Block Island Sound and the Atlantic Ocean on the east, and is fed by the East River, a part of the Hudson estuary, on the west (figure 5). Long Island Sound is a moderately stratified estuary dominated by strong tidal currents and freshwater inflow on its northern side. Several rivers (the largest being the Connecticut River) drain into the sound from the north shore, but most of this water is rapidly exchanged with the Atlantic Ocean. The bays which separate the northern and southern tips of eastern Long Island, principally Flanders, Great Peconic, Little Peconic, and Gardiners Bays, also are included as a part of this section.

### Aquatic Resources

a. Widespread species. Throughout Long Island Sound, the occurrence of the major commercially and recreationally important organisms is dependent on seasonal changes in water temperature. Sessile invertebrates, such as bay scallops,

oysters, and hard and soft clams, are located in beds throughout the Long Island Sound region. Oysters are one of the most valuable commercial fisheries in the Long Island Sound estuary.

Several fish species are year-round residents, including the winter flounder, one of the most abundant fish, tautog, and cunner. The latter two species are mainly fished for recreation. Coldwater species, such as cod and pollock, move into the sound from waters during the winter while more temperate water species, such as bluefish, scup, summer flounder, striped bass, and weakfish, inhabit the area during the summer. Anadromous fish, such as American shad, blueback herring, alewife, and the endangered shortnose sturgeon inhabit the sound and coastal tributaries during their spawning migrations.

b. Geographic inventory. The eastern end of the Long Island Sound subsection (grid reference BR55) provides winter habitat for cod and pollock populations, which generally inhabit cold offshore bottom waters. This area represents the southernmost point where large numbers of pollock occur inshore. Cod move offshore in March and April and pollock leave in June.

The Connecticut River (grid reference YA27) is a major anadromous fish spawning stream. The Federally endangered shortnose sturgeon migrates up this river; in 1977, the total adult population in the river was estimated at 450 fish. Alewife, American shad, rainbow smelt, and American tomcod also migrate up the Connecticut River to spawn.

The Peconic-Gardiners Bay Complex (grid references YA03 to YA35) is one of the more important northern centers for concentrations of weakfish. Weakfish use this complex as a spawning, nursery, and feeding ground. Shellfish also are abundant in this complex; some of the major mid-Atlantic coast bay scallop beds are located in the shallows and eelgrass beds of this area. Hard clams and oysters also are abundant.

Although other shallow water, hard bottom areas have important commercial oyster populations, Oyster Bay (grid reference XA23) is one of the more productive areas. Much of the oyster fishery in Long Island Sound, including Oyster Bay, is maintained by hatchery seed production and intensive bed management.

### Terrestrial Resources

a. Widespread species. The characteristic upland habitats on Long Island are the pitch pine and scrub oak forests and the extensive tidal wetlands which occur throughout the coastal areas. Several common wading bird and shorebird species inhabit the wetland areas during the spring and summer months. These species, and estimates of nesting pairs, include great black-backed gull (1,400 pairs), herring gull (5,400 pairs), common tern (3,100 pairs), least tern (1,400 pairs), roseate tern (800 pairs), black-crowned night heron (600 pairs), snowy egret (200 pairs), and glossy ibis (30 pairs).

b. Geographic inventory. An especially important wildlife area of Long Island, between grid references YA15 and YA55, contains many species, including nesting wading birds, shorebirds, songbirds, and ospreys. During fall and early winter, many songbirds and wintering hawks reside near the sound. A majority of the great black-backed and herring gulls of the zone nest in this locality. In

addition, the bog turtle, which is an endangered species in New York, breeds in this area. Peregrine falcons are known to frequent the area to the west (grid reference XA52) during migrations.

In spring, northern Nassau County (grid reference XA12 to XA31) is the focal point for many migratory birds, especially songbirds; several raptors nest in the county on a seasonal basis. In winter, many ducks and geese remain in the bays and marshes. Osprey, an endangered species in New York, also nests in this area.

#### 5.4 NEW YORK BIGHT (GRID REFERENCE BR55 TO WU00)

This section encompasses the exposed outer coast from Montauk Point, New York, to Cape May, New Jersey, and the Hudson River. The New York Bight has been divided into three subsections: the South Shore of Long Island, the Hudson River, and the New Jersey Shore.

##### 5.4.1 South Shore of Long Island (Grid Reference BR55 to WV98)

The South Shore of Long Island, from Montauk Point on the east to Sea Gate on the west, is dominated by barrier islands which protect an extensive system of bays and marshes on their landward side. This system includes Jamaica, Great South, Moriches, and Shinnecock Bays. The biotic resources for this subsection are keyed geographically using north-south UTM grid swaths.

#### Aquatic Resources

a. Widespread species. The South Shore of Long Island is an extremely critical area for spawning and nursery grounds as well as beds for major commercial and recreational shellfish and finfish, such as hard clam, bay scallop, soft shell clam, Atlantic menhaden, weakfish, striped bass, winter and summer flounder, and bluefish. Other fishery species are the surf clam, scup, Atlantic mackerel, and two coldwater species, cod and pollock, which move inshore during the summer. Species of special status which inhabit these coastal waters include six marine mammals, five sea turtles, and one fish (table 9). At the interface between the complex and the ocean, lobsters and mussels inhabit rocky areas.

b. Geographic inventory. Cod and pollock generally are coldwater, offshore bottom species, but during the fall individual schools move inshore. Both species may remain through the winter; cod move offshore in March and April and pollock leave in June. Montauk Point (grid reference BR65) is the southernmost area where large numbers of adult pollock occur nearshore.

The eastern portion of Long Island's South Shore, from Montauk Point to Moriches Inlet (grid reference BR65 to XA81), harbors an abundance of marine species, such as bluefish, striped bass, and black sea bass, which move inshore during the spring and summer. These species are not only of commercial value, but they also are of even greater recreational importance. Adult bluefish inhabit nearshore waters, but the eastern portion of the South Shore of Long Island is one of the few places along the Atlantic coast where bluefish can be caught from shore. Striped bass occur and are harvested along the entire Long Island South Shore. However, after adults spawn during the spring in the Hudson River, their largest summer concentrations are along the eastern portion of the subsection.

Great South Bay (grid reference XA30 to XA71), the largest bay along the Long Island South Shore, yields almost 50 percent of the nation's harvest of hard clams and contains major concentrations of bay scallops in eelgrass beds. Soft shell clams also are found in intertidal muds and gravels.

The surf clam, one of the major commercial shellfish in the subsection, has extensive beds from 3 to 16 kilometers (2 to 10 miles) offshore along the entire Long Island South Shore and between the shoreline and 27 meters (90 feet) along the western and central portions of the shore from Moriches Bay to the Lower Bay (grid reference XA81 to WV89).

During the summer, the western coastal waters of Long Island's South Shore from Fire Island Inlet to Lower Bay (grid reference XV49 to WV89) contain important concentrations of Atlantic mackerel and black sea bass.

### Terrestrial Resources

A significant portion of the tidal wetlands in New York occur in this subsection. Undeveloped uplands to the north are dominated by pitch pine and scrub oak forests. Although major portions of this area are urbanized, important concentrations of migratory and breeding wildlife still use the natural cover of the area.

a. Widespread species. The bays and inlets along the western portion of the Long Island South Shore are important nesting, stopover, and wintering areas for shorebirds, wading birds, and waterfowl. The most common species of shorebirds and wading birds, and their nesting pair estimates, are the great black-backed gull (400 pairs), herring gull (9,000 pairs), common tern (7,000 pairs), least tern (1,000 pairs), snowy egret (1,000 pairs), great egret (300 pairs), black-crowned night heron (900 pairs), and glossy ibis (900 pairs).

b. Geographic inventory. In the fall, Robert Moses State Park (grid reference XV49) has one of the most spectacular concentrations of migratory birds on Long Island. When northwest winds prevail, large flights of falcons, flickers, swallows, and landbirds rest at the park.

Nassau County (grid reference WV99 to XV39) is an especially important area for spring and fall migrating wading birds, shorebirds, waterfowl, and songbirds. Migrating birds often congregate in this area during periods of adverse weather to wait for more favorable conditions.

#### 5.4.2 Hudson River (Grid Reference XC02 to WV88)

The Hudson River, including New York harbor and the Lower Bay, is a tidal estuary which extends from the Atlantic Ocean to Troy, New York (grid reference XC03), a distance of 250 kilometers (155 miles). The river has four distinct reaches. The northernmost reach of the river in the study area, from Troy downstream to Beacon (grid reference XC03 to WA89), is freshwater with a small tidal current. From Beacon downstream to the channel widening at Stony Point (grid reference WA89 to WA86), tidal currents are sluggish in the very deep, narrow channel; brackish water seldom penetrates north of Beacon. Downstream, from Stony Point to the New York-New Jersey border (grid reference WA86 to WA39), the river becomes a broad and shallow complex, which includes Tappan Zee, Croton,

and Haverstraw Bays (grid reference WA86 to WA84); mixing of lighter freshwater with heavier seawater tends to trap nutrients in this reach during most of the year. The high-salinity, lower portion of the estuary, from the New York-New Jersey border to the river mouth (grid reference WA39 to WV89), is narrow, deep, and dominated by strong tidal currents. The biotic resources of this subsection are keyed geographically using east-west UTM grid swaths.

#### Aquatic Resources

a. Widespread species. As a result of the large salinity gradient (27 parts per thousand to zero) and habitat diversity in the Hudson River, many groups of organisms inhabit the river during part or all of their life history. Important anadromous species in the Hudson River include striped bass, American shad, blueback herring, alewife, tomcod, smelt, white perch, and the endangered shortnose sturgeon. All of these fish migrate upstream during the spring.

b. Geographic inventory. The Hudson River from Troy downstream to Poughkeepsie (grid reference XC03 to WB81) is inhabited by resident freshwater species such as catfish, sunfish, walleye, and freshwater bass. This reach and its tributaries is an important spawning, nursery, and feeding area for the anadromous species listed above. In particular, the American shad spawns in the shallows; the center of its peak spawning area is known as The Flats (grid reference WB85). Because The Flats is a critically important spawning area, it is closed to commercial fishing. Deep water occurs in this reach of the Hudson (grid reference WB82 to WB83) and may serve as an overwintering area for the endangered shortnose sturgeon. The only record in New York of a designated rare species, the pearl roach, was reported in the Roeliff Jansen Kill (grid reference WB96).

From Poughkeepsie to Haverstraw Bay (grid reference WB81 to WA86), the river changes from a freshwater regime to a medium-salinity estuary. Few resident freshwater species inhabit the mainstem of the river, although they are abundant in the tributaries. Bluefish, weakfish, and blue crab are present in the main channel area. Anadromous species use the littoral zone of the river as well as its tributaries for spawning, nursery, and feeding areas. Striped bass spawning is most intense in the Hudson River between Beacon and Peekskill (grid reference WA89 to WA87). The stretch from Beacon to Haverstraw Bay (grid reference WA89 to WA86) is relatively deep and may also provide overwintering habitat for shortnose and Atlantic sturgeons.

The Haverstraw-Croton-Tappan Zee Bay complex (grid reference WA86 to WA84) is a large, but nutrient rich, shallow water region. This complex is of critical importance as a nursery area for both estuarine-dependent organisms and anadromous species. It also is the last riverine feeding ground for young anadromous species before they migrate to sea; therefore, it serves as an important concentration area in the fall. Extensive shellfish beds and blue crab concentrations also are found in this area of the river.

The Hudson River, adjacent to New York City, mainly serves as a migration route for anadromous species, as well as juvenile and adult estuarine-dependent species which inhabit the upstream reaches of the river. Hard clams and soft shell clams, however, are present in the lower estuary, particularly in Sandy Hook Bay (grid reference WV78).

### Terrestrial Resources

The forested uplands adjacent to the Hudson River Valley are characterized by mixed forests consisting of oak and other northern hardwoods. Narrow belts of tidal wetlands are found along brackish portions of the river.

a. Widespread species. Although the Hudson River Valley is used by many birds for migration and breeding purposes, there are no known localities which have exceptionally large concentrations. Shorebird, wading bird, and marsh bird breeding sites along the river are not extensive.

b. Geographic inventory. Numerous hawks can be observed during migration at Hook Mountain (grid reference WA95) near Upper Nyack.

Waterfowl rest and overwinter in the southern portion (grid reference WA94 to WA81) of the area. Reptiles, particularly the five-lined skink and northern fence lizard, are known to concentrate at Anthony's Nose (grid reference WA87).

#### 5.4.3 New Jersey Shore (Grid Reference WV88 to WU00)

The New Jersey Shore, which extends from Sandy Hook to Cape May, is characterized by a high-energy sandy beach on the north and extensive estuaries protected by barrier islands along the coast to the south. Many of the barrier beaches have well-developed, but fragile, dunes and ridges. The biotic resources of this subsection are keyed geographically using east-west UTM grid swaths.

### Aquatic Resources

a. Widespread species. Several important shellfish, found in the coastal bays and nearshore ocean waters of New Jersey, include the hard clam, bay scallop, oyster, and blue crab. Oyster and blue crab provide a summer recreational fishery in the ocean bays. Surf clams are another important component of the nearshore ocean fishery and are found along the entire coast, especially in areas with coarse sandy sediment.

The extensive estuaries provide spring and summer nursery and feeding areas for many species, including American eel, Atlantic menhaden, white perch, striped bass, weakfish, spot, Atlantic croaker, northern kingfish, silver perch, summer flounder, and bluefish. Winter flounder occurs in the estuaries during the winter. Menhaden is a valuable commercial finfish species in New Jersey waters and is caught within 4.8 kilometers (3 miles) of the entire coast from spring through fall. Many other recreationally and commercially important estuarine-dependent finfish are harvested from spring through fall in bay and nearshore ocean waters. In the winter, offshore migration to deep water makes the finfish less abundant in coastal waters. New Jersey has a three-mile inshore limit where it is illegal to trawl for striped bass, so it is not of commercial importance within the coastal zone.

Most of the commercial and some of the recreational fishery of New Jersey occurs in Continental Shelf waters. Several species such as butterfish, scup, summer flounder, black sea bass, and Atlantic mackerel move inshore during the summer and are fished recreationally and commercially.

Six marine mammals, five sea turtles, and one fish species are considered threatened or endangered (subsection 5.2.1) and may be found in the New Jersey coastal waters.

b. Geographic inventory. The loggerhead turtle is the most common turtle with special status along the New Jersey coast; digs and crawls have been reported at Sandy Hook (grid reference WV87).

Striped bass is concentrated in the northern coastal waters of the New Jersey Shore from Point Pleasant to Atlantic City (grid reference WV83 to WU55). Offshore of Point Pleasant to Barnegat Light (grid reference WV83 to WV80), lobsters inhabit rocky substrates.

Several major shellfish beds are within the ocean bays of the northern half of the state. Oysters are of little commercial value in the ocean bays, but several seed beds are scattered throughout Toms River and the Mullica River (grid reference WV72 and WU47).

Hard clams inhabit the inlets and bays along the New Jersey coast between Barnegat Bay and Cape May (grid reference WV71 and WU00). Bay scallops are found in the rooted seagrass beds of Barnegat Bay and Little Egg Harbor (grid reference WV70 and WU68).

Nesting by the loggerhead turtle recently has been confirmed at Ocean City, New Jersey (grid reference WU34).

One of the two major New Jersey surf clam beds, the most valuable commercial fishery in the state, is 3 to 19 kilometers (2 to 12 miles) off the northern New Jersey coast in water depths of 15 to 37 meters (50 to 120 feet). The second major surf clam bed is in southern New Jersey, offshore of Wildwood (grid reference WU11), in water depths of 11 to 37 meters (35 to 120 feet). These two surf clam beds support the bulk of the U.S. clam fishery.

### Terrestrial Resources

Barrier beaches and marshes are characteristic of most of the New Jersey coastline. Hardwood forests, farmlands, and the unique pine barrens are important upland habitats. The pine barrens are extensive throughout southern New Jersey, but occur most often in the central interior. This unique area is characterized by a rich bird, reptilian and amphibian, and mammal community.

a. Widespread species. The New Jersey Shore provides seasonal, overwintering, and year-round habitats, as well as stopover sites for migratory birds.

During the spring and summer the New Jersey coast is an important nesting area for shorebirds; with the exception of the Delmarva Shore, the New Jersey Shore contains the highest total population of breeding shorebirds in the Middle Atlantic Zone. More than 43,000 nesting pairs of shorebirds are estimated to inhabit the coast. Common nesting species and estimated nesting pairs include common tern (4,300 pairs), least tern (1,800 pairs), herring gull (5,800 pairs), laughing gull (31,000 pairs), and black skimmer (1,000 pairs). This laughing gull population is the largest in the Middle Atlantic Zone.

The New Jersey Shore also harbors the highest total of breeding wading birds in the Middle Atlantic Zone; however, the total amount of breeding is small. Major wading bird species and estimated nesting pairs include snowy egret (28,000 pairs), glossy ibis (2,800 pairs), little blue heron (200 pairs), black-crowned night heron (1,400 pairs), and yellow-crowned night heron (140 pairs). Wading birds arrive in mid-March, and nesting typically is underway by early May and completed by mid-July. Most wading birds remain in the region until mid-fall, when they migrate south.

The New Jersey Shore is a major migratory route for thousands of ducks and geese in spring and fall; many ducks and geese also overwinter in the sheltered bays on the coast.

b. Geographic inventory. Several important protected wildlife habitats have been established along the New Jersey Shore. A major converging area for migrating waterfowl in winter, Long Beach Island (grid reference WU67 to WU79) is where thousands of brant concentrate in the intracoastal waterway.

Barneget National Wildlife Refuge (grid reference WU68) is a major stopover point for peregrine falcons during their migrations.

Bald eagles are of major concern along the New Jersey Shore area since none is known to have recently bred successfully here. Approximately ten bald eagle sightings were made in 1977 and 1978, and most of these were in the Mullica River-Brigantine National Wildlife Refuge area (grid reference WU57), which is an important wintering area for bald eagles along the New Jersey coast.

At Brigantine National Wildlife Refuge (grid reference WU56), large numbers of waterfowl occur in the fall, and concentrations of shorebirds, wading birds, and warblers occur in the spring. During October this refuge also harbors 90 percent of the Atlantic coast population of brant. Many waterfowl species may remain through mid-December, and on some occasions the waterfowl population has surpassed 150,000 individuals at Brigantine National Wildlife Refuge. During January and February, diving ducks, rough-legged hawks, short-eared owls, a few whistling swans, peregrine falcons, and large groups of sea ducks are known to inhabit this area. Substantial shorebird populations also occur, and black skimmers nest here in large numbers. The threatened roseate tern tends to concentrate only at Brigantine National Wildlife Refuge.

Osprey is endangered in New Jersey because its population level has declined in the last few decades; less than 100 pairs of osprey now nest in New Jersey. Most osprey pairs are in Cape May County (grid reference WU34 to WU01). These birds migrate south in fall; migration usually begins in late August. The major wading birds nesting area for most of the New Jersey Shore is at Stone Harbor, New Jersey (grid reference WU22), which contains over 2,600 nests.

In the fall, Cape May, New Jersey (grid reference WU00), probably has the largest concentration of landbirds of any other area on the Atlantic coast. In early August, tree swallows typically begin to arrive in large numbers. By mid-August, numerous kingbirds from the northeastern states and Canadian provinces arrive. Common flicker flights are spectacular from late September to early October. Other migrants to the New Jersey Shore include over one dozen raptor species, American woodcocks, American robins, and eastern bluebirds. By

December, the flights decline; however, many birds remain during the winter months.

#### 5.5 DELAWARE BAY AND DELAWARE RIVER (GRID REFERENCE WV25 TO VT99)

The Delaware River estuary extends from the limit of tidal influence at Trenton, New Jersey (grid reference WV25), to the mouth of the Delaware Bay between Cape May, New Jersey, and Cape Henlopen, Delaware (grid reference VT99). The Delaware River and the Delaware Bay form a highly productive and diverse system. The biotic resources of this section are keyed geographically using east-west UTM grid swaths.

##### Aquatic Resources

a. Widespread species. Several anadromous species, including shortnose and Atlantic sturgeon, American shad, alewife, blueback herring, white perch, and striped bass, migrate along the entire length of the Delaware estuary during spring spawning runs. The endangered shortnose sturgeon is distributed throughout the estuary, below Trenton.

b. Geographic inventory. The upstream portion of the estuary from Trenton, New Jersey (grid reference WV25), south to Wilmington, Delaware (grid reference VU59), is populated by freshwater species such as sunfish, catfish, bullhead, and bass and provides spawning and nursery areas for anadromous species.

South of Wilmington (grid reference VU59), numerous marshes, creeks, and shallows along Delaware Bay are major nursery grounds for estuarine-dependent species such as the blue crab, Atlantic menhaden, several drum species, bluefish, and summer and winter flounder. Adults of these species inhabit the lower parts of the river, but the species are more abundant south of grid reference VU74.

Commercially important invertebrates, such as blue crab, American oyster, hard clam, mussel, whelk, and lobster occur in the lower portions of the estuary (downstream from grid reference VU65). Blue crab, the major commercial species in the Delaware Bay, is commercially fished throughout the bay during the entire year; in the summer, crab is fished recreationally in shallow water areas. Oysters are another major fishery in the Delaware Bay. Delaware and New Jersey maintain seed beds (grid references VU65, VU64, VU62, and VU74) and planting grounds (grid references VU72, VU73, and VU93). The area from grid reference VU56 to Cape May Canal (grid reference WU01) is an area of high oyster set. The potential exists to double oyster seed production in the bay, if the oyster drill can be controlled in this area.

Hard clams prefer salinities greater than 20 parts per thousand; therefore, major beds for this species are found in the lower portion of the Delaware Bay (grid references VU73, VU72, VU71, VU70, VT89, and VU91). Mussels, whelks, and lobsters also inhabit the lower bay; lobsters, in particular, are found mainly at the Delaware breakwater off Cape Henlopen (grid reference VT99).

##### Terrestrial Resources

Terrestrial habitats along the Delaware River consist primarily of salt-water and freshwater marshes, hardwood forests, and farmlands. The Delaware Bay has several significant areas for plant and wildlife resources.

a. Widespread species. The most common shorebird species in the Delaware Bay area include greater and lesser yellowleg, short-billed dowitcher, pectoral, least, stilt, semipalmated, and western sandpiper, marbled godwit, and black-necked stilt, as well as many gulls and terns. Several unusual tern species in the Delaware Bay area include the royal, caspian, roseate, and black terns. Occasionally, black-headed and little gulls gather here, but few birds nest in the Delaware Bay and no major colonies are known to exist. Also, a large resident population of loons and grebes remains in the Delaware Bay throughout the year.

b. Geographic inventory. White Clay Creek (grid reference VU39) is an unpolluted and undeveloped waterway containing diverse fauna and rare flora such as the purple fringeless orchid. The creek is considered to be a prime location for songbird diversity on a year-round basis, and serves as a habitat for the rare bog turtle.

The largest deer concentration in Delaware occurs at Whitely Farms (grid reference VU39), where populations are estimated at 300 head per 688 hectares (1,700 acres).

A large concentration of the rare orchid, the pink lady's slipper, can be found in bloom during May at Moccasin Woods (grid reference VU38) in northern Delaware.

From spring to fall, many species of wading birds occupy marsh habitats throughout the Delaware Bay area; however, the only major nesting site occurs at Pea Patch Island (grid reference VU58) where more than 7,000 pairs of wading birds nest, including little blue heron (600 pairs), cattle egret (4,000 pairs), great egret (250 pairs), snowy egret (1,000 pairs), Louisiana heron (50 pairs), black-crowned night heron (400 pairs), yellow-crowned night heron (50 pairs), and glossy ibis (700 pairs). This is the largest breeding population of cattle egret in the Middle Atlantic Zone. Pea Patch Island is one of the larger heronries in the northeastern United States and is considered to be a unique breeding area of national significance.

An important shorebird habitat in northern Delaware is located at Thousand Acre Marsh (grid reference VU47).

The only known major breeding site of the eastern tiger salamander, an endangered species in Maryland, is found at grid reference VU35.

Woodland Beach Wildlife Area (grid reference VU55) is an important stopover place for peregrine falcons. The Delaware Bay is a nesting site for the endangered bald eagle. Only one of the three major wintering areas for the bald eagle in the section occurs in New Jersey at grid reference VU85 along the Delaware Bay.

One pair of adult eagles usually nests at Bombay Hook National Wildlife Refuge (grid reference VU64) from early December to about mid-May. Bombay Hook also is a prime stopping place for peregrine falcons, ducks, and Canada geese. The Canada goose population in this area peaks at 50,000 birds. Many of the more than 300 species of birds identified at the refuge breed here. Many mammals

common to coastal areas also reside here, such as deer, squirrel, fox, muskrat, and a few otter.

One of New Jersey's major ornithological events is the large concentration of snow geese in the Delaware Bay near Fortescue, New Jersey (grid reference VU84), in late March. The snow geese arrive in early November and remain until the ice forces them to migrate south. They reappear in late February and remain until early April.

Peregrine falcons migrate through and stopover at Little Creek Wildlife Area (grid reference VU63). Farther to the south, at Higbee Beach, New Jersey (grid reference WU01), is one of the most productive muskrat areas in the country. More than one lodge per acre has been counted on the several hundred acres of Pond Creek Meadow.

Delaware's most abundant growth of the rare pitcher plant and the last remaining large concentrations of Atlantic white cedar in the Delaware River Basin are found at Beaver Dam Branch (grid reference VU60).

#### 5.6 DELMARVA SHORE (GRID REFERENCE VT99 TO VS10)

The Delmarva Shore encompasses portions of Delaware, Maryland, and Virginia and extends from Cape Henlopen, Delaware (grid reference VT99), in the north to Cape Charles, Virginia (grid reference VS10), in the south. This section is physically and biologically similar to the New Jersey Shore (subsection 5.4.3). The Delmarva Shore is characterized by a system of barrier islands which protect an extensive estuarine-tidal marsh system. The biotic resources of this section are keyed geographically using east-west UTM grid swaths.

##### Aquatic Resources

a. Widespread species. The Delmarva bays are an important habitat for invertebrate species such as hard clams, blue crabs, and oysters.

Finfish, such as the American eel, Atlantic menhaden, white perch, striped bass, weakfish, spot, Atlantic croaker, northern kingfish, silver perch, summer and winter flounder, and bluefish, use the estuaries of the Delmarva Shore in the spring and summer as juvenile nursery areas. With the exception of winter flounder, these estuaries also are used as adult summer feeding grounds. These species, excluding the menhaden, are all of recreational and commercial importance. The menhaden, fished exclusively as a commercial species, is the most valuable finfish with the highest pound yield of any commercial species along the Delmarva coast. Recreationally and commercially important oceanic fishes such as black sea bass, scup, and Atlantic mackerel also occur in the coastal waters of the Delaware Bay during the summer.

Offshore, the same endangered and threatened species that were discussed in the Resources Overview (subsection 4.2.1) occur, including the six marine mammals, five sea turtles, and two fishes. The fishes include the Federally listed shortnose sturgeon and the Virginia-listed Atlantic sturgeon.

b. Geographic inventory. Maryland waters (grid reference VT95 to VT70) contain the major surf clam beds along the Delmarva Shore. These beds are mainly

from 5 to 113 kilometers (3 to 70 miles) offshore, in water depths of 6 to 33 meters (18 to 110 feet).

The coastal bays of Virginia south of Chincoteague (grid reference VS59 to VS10) contain major oyster concentrations. The oysters present in Chincoteague Bay (grid reference VT71 to VS69) are mainly the result of seeding and transplanting. This effort is being undertaken since the present natural reproductive rates are too low to sustain a harvestable population. The ocean beaches in the Chincoteague-Wallop Island area (grid reference VS69) provide potential nesting habitat for the threatened loggerhead turtle.

### Terrestrial Resources

a. Widespread species. The many marshes, inlets, and bays of the Delmarva Shore provide excellent habitats for a large variety of species, especially migrating birds. The many small bays and barrier islands provide protective havens for thousands of waterfowl and other waterbirds. Peak spring migrations occur between late February and the end of March and in the fall from mid-October to mid-December. Noteworthy species that traverse the coastal flyway include brant, snow geese, white-winged scoters, red-breasted mergansers, red-throated loons, double-crested cormorants, northern gannets, common loons, horned grebes, Canada geese, black ducks, mallards, and greater and lesser scaup. Other regular winter visitors are common and king eiders.

Songbirds are most abundant along the Delmarva Shore section from spring through fall, and many birds nest here.

b. Geographic inventory. In Delaware, large shorebird migrations occur during May and from the first of August to early October. The most common species and nesting pair estimates include laughing gull (33,500 pairs), royal tern (4,700 pairs), common tern (4,700 pairs), herring gull (3,200 pairs), black skimmer (2,800 pairs), and Forster's tern (1,400 pairs). Cape Henlopen State Park (grid reference VT98) is an important area for shorebirds, gulls, waterbirds, and landbirds.

The Rehoboth Bay (grid reference VT97) area harbors the most productive nesting colony of ospreys in Delaware, where in 1975, 16 nests produced 21 young. Many shorebirds, waterfowl, and other waterbirds also winter here.

Many waterfowl overwinter at Assawoman Wildlife Area (grid reference VT95) and principal migration stopovers occur in May for waterbirds, shorebirds, warblers, and other landbirds.

Wading birds are common along the Delmarva coast during the warmer months, but are not as abundant as shorebirds; nor do they concentrate in nesting colonies in as high numbers as do shorebirds. Few wading birds nest in coastal Delaware or Maryland; however, in Maryland, the cattle egret (960 pairs) and snowy egret (500 pairs) are common.

Ocean City, Maryland (grid reference VT94), is an important area for shorebirds, whose peak numbers occur May through September; in September and October migratory seabirds and passerines arrive. Many of these birds also nest here.

Assateague Island National Seashore (grid reference VT94 to VS69) and Chincoteague National Wildlife Refuge (grid reference VT70 to VS69) are important for migrating peregrine falcons, herons, shorebirds, and migratory landbirds. Many brant and snow geese and thousands of ducks overwinter here. During August, September, and April, there are numerous shorebirds, and in the summer some ducks, terns, gulls, and songbirds nest in this area. Chincoteague also is famous for its wild ponies, which are believed to be descendants of a Spanish herd shipwrecked in the 1500's.

Along the Delmarva coast, the Delmarva fox squirrel is found only on Assateague Island (grid reference VT94 to VS69).

Shorebirds nest on the many barrier islands along the southern, or Virginia portion (grid reference VS69 to VS10), of this section. Some sites have high densities of nesting pairs.

Most breeding of wading birds in this section takes place in the Virginia portion of the Delmarva peninsula (grid reference VS69 to VS10). The most common nesting species, and estimates of nesting pairs, are snowy egret (3,000), black-crowned night heron (1,800), cattle egret (1,300), Louisiana heron (700), great egret (500), and glossy ibis (500).

Cobb Island (grid reference VS33) is a significant shorebird nesting site on the Atlantic coast, particularly for gulls and terns, due to the large size of colonies and the diversity of the nesting species found here.

At Cape Charles, Virginia (grid reference VS10), many landbirds concentrate in the fall for short periods before migrating south. Most of the species common to the Middle Atlantic Zone can be found here at some time of the year, including flycatchers, swallows, chickadees, nuthatches, wrens, thrushes, vireos, warblers, and sparrows. Cape Charles also is a stopover area for many migrating hawks and tree swallows.

Fisherman Island National Wildlife Refuge (grid reference VS10) harbors nearly all of the nesting royal terns in the Middle Atlantic Zone, as well as large populations of many other species.

## 5.7 CHESAPEAKE BAY (GRID REFERENCE UU99 TO VR17)

The Chesapeake Bay is the largest estuary in the United States. The bay extends a distance of 290 kilometers (180 miles) from Conowingo Dam on the Susquehanna River (grid reference UU99) southward to the mouth of the bay at Cape Henry and Cape Charles (grid reference VR17). This complex also contains numerous estuarine tributaries such as the Chester, Choptank, Patuxent, Nanticoke, Potomac, Pocomoke, Rappahannock, York, and James Rivers. The total surface area of the bay is approximately 11,400 square kilometers (4,400 square miles). The biotic resources of the Chesapeake Bay are keyed geographically using east-west UTM grid swaths unless otherwise noted.

### Aquatic Resources

The Chesapeake Bay has a great diversity and abundance of aquatic organisms because of its large size, nutrient input, high productivity, and unique physical-chemical characteristics.

a. Widespread species. A variety of organisms inhabit the various salinity gradients of the Chesapeake Bay. Some organisms complete only part of their life history in the bay. Phytoplankton and rooted aquatic vegetation are important energy producers in the Chesapeake estuary. These plants occur throughout the estuary, but their distribution (table 11), is influenced by water salinity, substrate, or tidal inundation.

In addition to the abundant plant life, the biota include such freshwater organisms as the white and channel catfish and the brown bullhead; estuarine-dependent species such as Atlantic menhaden, Atlantic croaker, spot, weakfish, bluefish, and summer and winter flounder; truly estuarine species, including blue crabs, oysters, hard and soft clams, killifishes, silversides, anchovies, hogchoakers; marine species such as black sea bass, scup, northern puffer, sheepshead, spadefish, cobia, and cownose ray; and diadromous species such as American eel, striped bass, white perch, American shad, blueback herring, alewife, and Atlantic and shortnose sturgeon. The Atlantic sturgeon, designated by Virginia as an endangered species, is found throughout the Chesapeake Bay during its spring spawning runs; the shortnose sturgeon, a Federally endangered species, is rarely encountered in the Chesapeake Bay. Stocks of American shad have become depleted within the Chesapeake Bay. As a result, commercial fishing for this species was banned in Maryland during the 1980 season.

b. Geographic inventory. The regional geographic distribution of aquatic organisms in the Chesapeake Bay is determined by water salinity. This geographic inventory, therefore, is based on those salinity differences; few grid references are included because the positions of salinity gradients change with varying freshwater inflow and other factors.

The nontidal and tidal freshwater portions of the Chesapeake Bay (0 to 5 parts per thousand) contain major spawning or nursery areas for numerous species of fish, such as the anadromous herrings. The American shad spawns in shallow tidal flats of bay tributaries from March to May. The alewife spawns in small nontidal freshwater streams during late March and April, but the blueback herring spawns in tidal freshwater tributaries during April and May. White perch spawns in the shallow tidal freshwater tributaries in the spring. The striped bass, one of the most important fisheries in the bay, is more restrictive in its spawning distribution and prefers specific tidal freshwater rivers. The importance of the Chesapeake Bay to the entire East Coast striped bass population cannot be understated since a majority of this species spawns in the bay.

Although many fish inhabit the freshwater portions of the bay, the channel catfish prefers the upper Potomac River (grid reference UT07) and the Susquehanna Flats area (grid reference VU06). Similarly, although juvenile spot, weakfish, and croaker are found in nursery areas throughout the bay, they are concentrated mainly in the tidal freshwater (grid reference VU27 to UU95, UT07 to UT04, VU14 to VU03) and in major tributaries where similar salinities are found.

The middle-salinity portion of the bay (5 to 15 parts per thousand) contains many of the truly estuarine shellfish species; these species make up a majority of the valuable Chesapeake harvest. Oysters are distributed widely throughout the bay. Because oyster populations in the bay have declined, Maryland and Virginia transplant oysters or spat from highly productive areas to areas of the bay with low densities. The James River between Jamestown and Newport News (grid

Table 11. Rooted aquatic vegetation in the Chesapeake Bay.

<u>Species</u>	<u>Distribution<sup>a</sup></u>
<b>Marsh Plants</b>	
Pickerelweed	1 (deep open water)
Yellow waterlily	1 (deep open water)
River bulrush	1 (shallow margins)
Rosemallow	1 and 2 (shallow margins)
Phragmites	1 and 2 (shallow margins)
Wildrice	1 and 2 (shallow margins)
Big cordgrass	1 (intermediate depth)
Narrowleaf cattail	2 and 3 (headwaters, protected areas)
Olney three-square	2 and 3 (all areas) 4 (poorly drained depressions)
Common three-square	3 (shallow margins)
Dwarf spikerush	3 (mudflats)
White waterlily	3 (ponds, creeks)
Hightide bush	4 and 5 (high margins)
Salt meadow cordgrass	4 and 5 (well-drained meadows)
Salt marsh cordgrass	4 and 5 (well-drained meadows and tide flats)
Saltgrass	4 (all areas) 5 (poorly drained depressions)
<b>Rooted Aquatic Plants</b>	
	<u>Percentage of the total water area</u>
Wildcelery	Less than 15 percent
Eurasian watermilfoil	Less than 15 percent
Waterweed	Less than 15 percent
Sago pondweed	Entire bay
Redheadgrass	Greater than 5 percent
Widgeongrass	Greater than 5 percent
Eelgrass	Greater than 5 percent

SOURCE: Lippson, 1973.

<sup>a</sup>key: 1 = Freshwater estuaries river marsh  
 2 = Brackish water estuaries river marsh  
 3 = Fresh estuarine bay marsh  
 4 = Brackish estuarine bay marsh  
 5 = Salt estuarine bay marsh

reference US51 to UR78) is a major seed production area which supplies oyster spat for most commercial beds in the Chesapeake Bay.

Soft clams also are abundant in the middle-salinity portion of the estuary. Commercial concentrations in Maryland occur between the Potomac and Chester Rivers (grid reference UT70 to UU73, east to west). Many of the known winter flounder spawning areas occur in the mid-estuary portions (grid references VU16, VU72, UU91, UT99, UT97, VT13, UT74, and UT71) where these fish move to channel waters during February and March.

The high-salinity portions of the Chesapeake Bay (higher than 15 parts per thousand) harbor the blue crab, another major recreationally and commercially important species in the bay. Blue crab spawn near the mouth of the Chesapeake Bay during late summer and early fall, and to a lesser extent, in the spring. Virginia has set aside a portion of the area around Norfolk, Cape Charles, and Cape Henry (grid reference UR89 to VR18 to VS10) as a sanctuary for blue crab spawning. In Virginia, blue crab harvesting is permitted throughout the year, but in Maryland it is restricted to the nonwinter months.

The high-salinity areas of the bay also have the highest commercial and recreational yield for many finfish species, including several marine species, menhaden, and drum. Menhaden, the most valuable finfish in the bay, comprises the majority of the total commercial fishing poundage; it is harvested mainly in the lower bay from March through December. The menhaden fishery consists mostly of immature fish. The highest commercial and recreational yield of spot, croaker, weakfish, silver perch, spotted seatrout, black and red drum, and northern and southern kingfish occurs in the high-salinity portions of the Chesapeake Bay where the adults tend to concentrate.

### Terrestrial Resources

The uplands of the Chesapeake Bay have a great variety of habitats for many wildlife species. In addition to pine flatwoods and oak forests in the upland areas, bottomland hardwood forests occupy the flood plains of major rivers, while numerous salt, brackish, and freshwater marshes are common on the shores of the bay.

a. Widespread species. The cypress-gum swamp forest reaches its northern limit in the Maryland portion of the bay.

The Chesapeake Bay is a major wildlife habitat for the Middle Atlantic Zone, especially for birds. More than 75 percent of the Atlantic flyway waterfowl population, about 550,000 ducks and 350,000 geese, winter in the tidewater areas of the bay.

Most of the bald eagles found in the Chesapeake Bay area are permanent residents, although a small number of these eagles may fly northward in summer. Between 1972 to 1977, the number of active eagle nests sighted in the bay area increased from 59 to 77. In 1977, 47 young were hatched as compared to 13 in 1970. With one or two exceptions, no other active nests occur in the mid-Atlantic region.

The Delmarva fox squirrel presently exists only in portions of the Delmarva Peninsula. Its population has not been established for the Eastern Shore of the Chesapeake Bay.

The Chesapeake Bay has many resident wading birds, although the total number of nesting pairs (6,000) is lower than adjacent coastal areas. The bay is a major nesting area in the Middle Atlantic Zone for the great blue heron. In the bay area, the most common nesting wading bird species and their nesting pair estimates are great blue heron (2,000 pairs), snowy egret (1,200 pairs), great egret (1,000 pairs), black-crowned night heron (900 pairs), cattle egret (500 pairs), Louisiana heron (200 pairs), glossy ibis (150 pairs), and yellow-crowned night heron (42 pairs).

The Chesapeake Bay is an annual stopping point for more than 1 million migrating waterfowl. Hundreds of thousands of ducks and geese and thousands of swans migrate, stopover, or overwinter in many of its bays, rivers, and marshes. Local concentrations of diving ducks, including canvasback, are scattered throughout the upper Chesapeake Bay.

The most numerous and widely distributed dabbling ducks which winter in the bay are mallards and black ducks. Lesser scaups, old squaws, surf scoters, and white-winged scoters are the most abundant ducks. These species of waterfowl breed and nest in the Chesapeake Bay area between late-March and mid-June. Wood ducks are usually rare visitors to coastal areas; however, a few thousand wood ducks inhabit and breed in inland wooded swamps and along wooded streams of the bay.

More than 500,000 Canada geese migrate to the bay annually. They begin to arrive by the end of September and generally leave during the period between the end of February and April. Snow geese and swans arrive in early October.

Shorebirds arrive in the bay from the beginning of May to mid-June; they generally depart during the period from the end of July to early October. Major nesting species and maximum nest counts include herring gull (100 pairs), common tern (1,000 pairs), least tern (700 pairs), black skimmer (50 pairs), Forster's tern (100 pairs), and great black-backed gull (30 pairs).

A number of bird migration routes converge at the Chesapeake Bay. Major flights of whistling swan, American widgeon, canvasback, ruddy duck, and other waterfowl occur along the Susquehanna River and Chesapeake Bay. Brant and snow geese follow the ocean coast along with many other waterbirds. Ring-billed and Bonaparte's gulls and a number of waterfowl species use the Potomac River as a flyway. Hawks generally follow low ridges and the coast during their migrations.

Muskrats are the most abundant furbearing species and are a commercially valuable furbearer in the bay. Over 400,000 muskrats are harvested annually. The largest muskrat populations occur in the brackish water marshes of the lower Eastern Shore. River otters also are widely distributed throughout the streams, rivers, and marshes of this area.

The beaver has been reintroduced in the bay area through stocking programs and natural immigration. The beaver's range includes most of the bay's western

shore tributaries, and two separate populations inhabit the upper and central portions of the Eastern Shore.

b. Geographic inventory. Two known peregrine falcon hacking areas are on Aberdeen Proving Ground and Carrol Island (grid reference UU85).

Other species of special value in the Chesapeake Bay area include the eastern tiger salamander, which is now found in Maryland only at a few breeding ponds in Kent County (grid reference VU34).

Many species of songbirds concentrate in the fall at Eastern Neck National Wildlife Refuge (grid reference UU92). These species include flycatchers, jays, thrushes, vireos, and sparrows. In addition to songbirds, ospreys and many other species may be found at Eastern Neck, including waterfowl, great blue herons, shorebirds, Delmarva fox squirrels, deer, and nutria. Of the approximately 1,450 breeding pairs of osprey throughout the Chesapeake Bay, the ospreys at Eastern Neck have maintained their population levels. These birds nest during the summer months and migrate south for the winter. Thousands of monarch butterflies also frequent portions of this area during their migration in August.

Many shorebirds occur during the May through October period at Sandy Point State Park (grid reference UU72). It is also a concentration point for waterfowl and songbirds and represents the most productive bird-watching spot on the western shore of the Chesapeake Bay. It is an excellent locale for observing hawk flights in April and in late-October.

In winter, whistling swan is common in the areas of the Choptank River (grid reference UT97), while brant winters primarily along bays below the Little Choptank River (grid reference UT96).

The largest great blue heron rookery in the Middle Atlantic Zone is on Nanjemoy Creek (grid reference UT05), and it often contains up to 750 nests. Herons nest during mid-March to mid-July in colonies which range from a few to many pairs of birds. Although most migrate southward, a limited number of herons overwinter in this area.

Important wildlife species in Blackwater National Wildlife Refuge (grid reference VT05) include the bald eagle, Delmarva fox squirrel, whitetail and sika deer, nutria, and many waterfowl. In mid-November, peaks of 85,000 ducks and 100,000 Canada geese may be found on this 4,775-hectare (11,800-acre) refuge. Nutria is an introduced species and prefers marsh habitats in the middle portions of the bay. Blackwater National Wildlife Refuge has about 8,900 nutria. Nutria is a prolific species which generally produces two to three litters per year.

Lower Hooper Island (grid reference UT93) is a concentration point in the fall for an unusually large number of migrating sharp-shinned hawks, American kestrels, and common flickers.

Point Lookout State Park (grid reference TT81) is an important observation point for waterfowl. In addition, thousands of migrating flycatchers, thrushes, vireos, warblers, and sparrows stopover at this park during their fall migration.

Presquile National Wildlife Refuge (grid reference TS93 and US03) is an important land-use area, since many warblers breed at the refuge, including prothonotary, yellow-throat, black and white, prairie, pine, hooded, Kentucky, and northern parula. Numerous other songbirds, whitetail deer, waterfowl, bob-white, turkey, red fox, muskrat, otter, and a variety of butterfly species also seek protection at this site.

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## PART 6

### SOUTH ATLANTIC ZONE

#### 6.1 INTRODUCTION

For best results, much of the preparatory information in parts 1, 2, and 3 should be read before using the maps or using the information in this part. This part presents some of the physiographic, land-use, and geographic features of the South Atlantic Zone and the characteristics and habits of some of the major biological resources.

##### 6.1.1 Physical Description

The South Atlantic Zone (figure 6) extends from Cape Henry, Virginia, southward to Garden Cove, Florida (grid reference VR18 to NU88). This zone includes the 64-kilometer (40-mile) coastal area of Biscayne Bay, which originally was part of Terrell's Southern Florida Zone. The South Atlantic Zone extends for a distance of about 1,610 kilometers (1,000 miles) and comprises approximately 45 percent of the Atlantic coast study area. The sections within the zone are the Pamlico Sound Complex, Virginia-Carolina Coast, Sea Islands, East Florida, and Biscayne Bay. The Virginia-Carolina Coast section is subdivided into two subsections: the seaward shore from Cape Henry, Virginia, to Cape Lookout, North Carolina, and the coastal zone from Cape Lookout, North Carolina, to Winyah Bay, South Carolina. One of the main environmental factors affecting this zone is the fusing of the Florida Current with the Antilles Current to form the Gulf Stream.

The ecological inventory of the South Atlantic Zone is covered by portions of the following USGS 1:250,000-scale maps:

- Norfolk, VA; NC
- Eastville, VA; NC; MD
- Manteo, NC
- Rocky Mount, NC
- Beaufort, NC
- Florence, SC; NC
- Georgetown, SC; NC
- James Island, SC
- Augusta, GA; SC
- Savannah, GA; SC
- Brunswick, GA
- Jacksonville, FL; GA
- Daytona Beach, FL
- Orlando, FL
- Fort Pierce, FL
- West Palm Beach, FL
- Miami, FL.

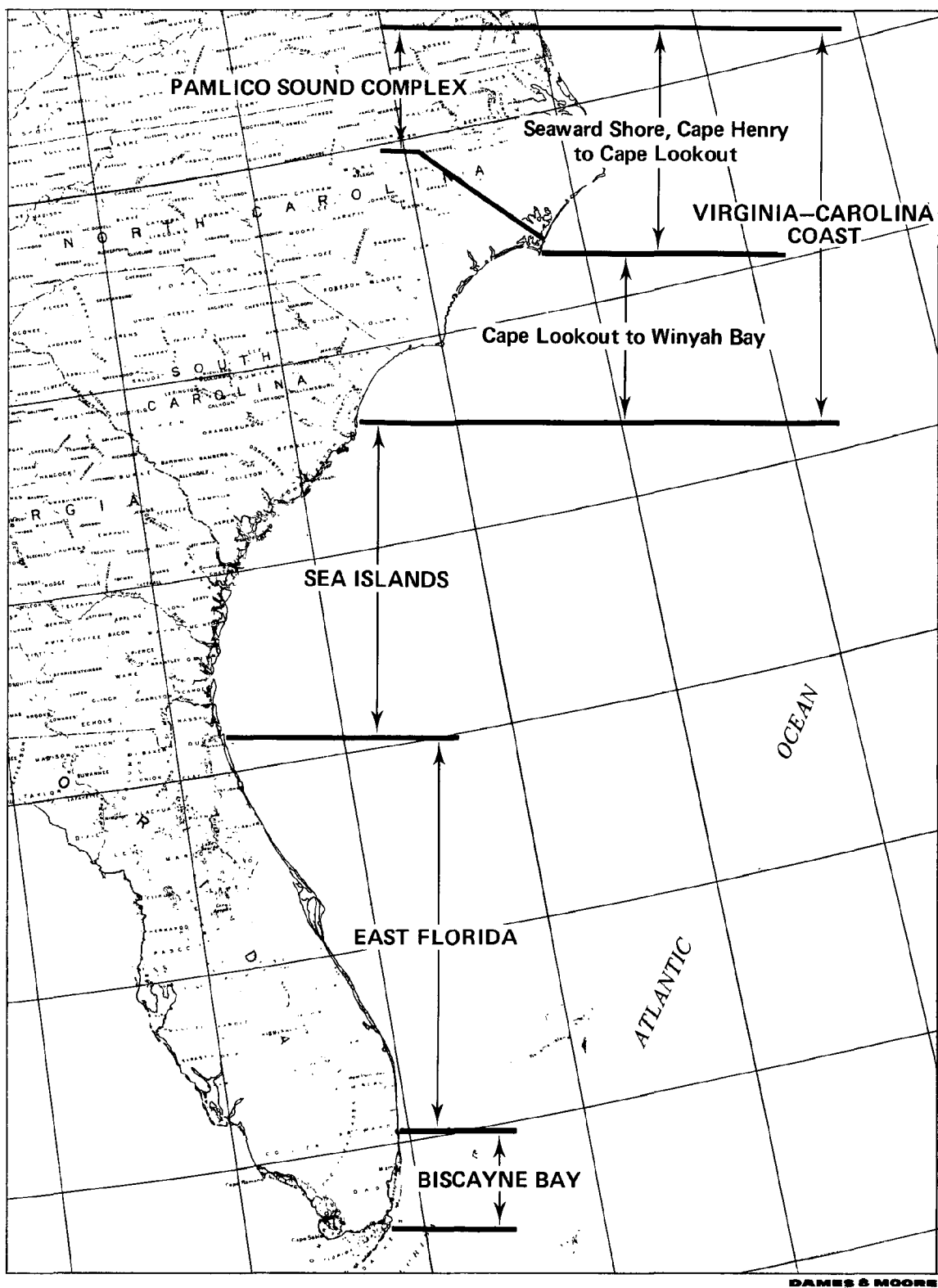


Figure 6. Major sections and subsections of the South Atlantic Zone.

The northern section of the South Atlantic Zone, extending from Cape Henry to Cape Lookout, is characterized by long, narrow barrier islands with wide sandy beaches which protect broad sounds rimmed with seagrass beds and tidal marshes. This section receives relatively large amounts of freshwater inflow.

From Cape Lookout to the St. John's River, the barrier islands are short, the bays are narrow, and tidal marshes occupy a greater portion of the bays. The beaches are broad and consist of white sand.

The Sea Islands section of South Carolina and Georgia is characterized by numerous irregularly shaped islands which protect some of the most expansive tidal marshes in the world. These marshes are highly dissected by coastal plain rivers and distributaries which contribute considerable amounts of freshwater.

The barrier islands of the East Florida section are long and narrow and generally front high-salinity lagoons. Freshwater inflow from the coastal plain is scant.

The South Atlantic Zone, with the exception of southern Florida, lies within southeastern evergreen forests dominated by flatwood pines consisting mostly of longleaf pine in the uplands and slash pine in poorly drained areas. These forests are succeeded by such hardwoods as oaks, hickory, and magnolia, and many inland areas have predominantly upland hardwoods or transitional forests of hardwood and pine. Typical riverine communities consist of cypress-gum associations with baldcypress and water tupelo being the dominant trees and epiphytic "Spanish moss" on the flood plain. Scattered throughout the mid-portion of the South Atlantic Zone are savannahs consisting of open stands of pine or cypress with a thick, herbaceous understory scattered in large areas of grassland.

In southern Florida, the Continental Shelf becomes narrow and high-relief coral reefs begin to dominate the nearshore coastal zone. Southeastern evergreen forests give way to subtropical broadleaved evergreen forest. The Biscayne Bay section has a low-lying, swampy coastline with characteristic mangrove communities. The area is dominated by the marine influence of the Atlantic Ocean, because freshwater inflow is highly variable.

#### 6.1.2 Special Land-Use Areas

Within the South Atlantic Zone, a total of 160 special land-use areas (table 12) have been identified, including 12 aquatic preserves in Florida.

Of the 160 special land-use areas, 43 are under Federal jurisdiction, 110 are under state jurisdiction, and the remaining 7 are privately owned areas. Three national wildlife refuges are designated as Class I air quality areas. Over two-thirds of the areas are significant as natural areas and include parks, remote islands, and estuaries which are important to nesting birds and fish, and also wildlife management or hunting areas. More than half of the areas are recreationally significant, ranging from refuges, forests, estuaries, and parks to open space and hunting areas. A few areas are designated as having historic or cultural significance. Because of scale limitations, all of the historic sites in the urban areas of the South Atlantic Zone have not been shown on the maps.

Table 12. Fish and Wildlife Service land use designations for the South Atlantic Zone.

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>VIRGINIA</u>						
Back Bay National Wildlife Refuge	X			X		
Trojan Waterfowl Management Area		X		X		X
Poahontas Waterfowl Management Area		X		X		X
<u>VIRGINIA-NORTH CAROLINA</u>						
Mackay Island National Wildlife Refuge	X			X		
Great Dismal Swamp National Wild- life Refuge	X			X		
<u>NORTH CAROLINA</u>						
Northwest River Marsh Game Land		X		X		X
North River Game Land and Bear Sanctuary		X		X		X
Dismal Swamp State Park		X		X		X
Merchants Millpond State Park		X		X	X	X
Chowan Swamp Game Land		X		X		X
Bertie Game Lands		X		X		X
Georgia-Pacific Game Land		X		X		X
Scuppernong Game Lands		X		X		X
Bull Bay Game Land and Bear Sanctuary		X		X		X

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NORTH CAROLINA (cont'd)</u>						
Pettigrew State Park		X				X
New Lake Game Lands and Bear Sanctuary		X		X		X
Dare Game Land and Bear Sanctuary		X		X		X
Fort Raleigh National Historic Site	X				X	
Pea Island National Wildlife Refuge	X			X		
Mattamuskeet National Wildlife Refuge	X			X		
Gull Rock Game Land and Bear Sanctuary		X		X		X
Swanquarter National Wildlife Refuge/ Swanquarter Wilderness*	X			X		
Pungo National Wildlife Refuge	X			X		
Texas Gulf Game Land		X		X		X
Goose Creek State Park		X				X
Big Pocosin Game Land		X		X		X
Goose Creek Game Land		X		X		X
Tuscarora Game Land		X		X		X
Croatan National Forest				X		X
Lukens Island Game Land		X		X		X
Cedar Island National Wildlife Refuge	X			X		
Jarrett Bay Game Land and Bear Sanctuary		X		X		X

\* Class I air quality area.

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>NORTH CAROLINA (cont'd)</u>						
Barbours Hill Waterfowl Management Area		X		X		X
Wright Brothers National Memorial	X				X	
Jockey's Ridge State Park		X				X
Cape Hatteras National Seashore	X				X	X
Cape Lookout National Seashore	X					X
Fort Macon State Historic Park and Recreation Area						
Theodore Roosevelt Natural Area		X			X	X
Hammocks Beach State Park		X		X		X
White Oak River Impoundment Game Land		X		X		X
Hofmann State Forest		X		X		X
Angola Bay Game Land		X		X		X
Holly Shelter Game Land		X		X		X
Catfish Lake Game Land		X		X		X
Carolina Beach State Park		X		X		X
Penderlea Game Land		X		X		X
Moores Creek National Military Park						
Green Swamp Game Land and Bear Sanctuary	X				X	
		X		X		X
<u>SOUTH CAROLINA</u>						
Buist Game Management Area		X		X		X
Myrtle Beach State Park		X				X

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>SOUTH CAROLINA (cont'd)</u>						
Waccamaw Game Management Area		X		X		X
Brookgreen Gardens			X	X	X	
Huntington Beach State Park		X				X
Samworth Game Management Area		X		X		X
Walker Farm Game Management Area		X		X		X
Hobcaw Barony Forest Research Center		X		X		
Belle Isle Gardens			X	X		
Kilsock Game Management Area		X		X		X
Wildhorse Game Management Area		X		X		X
Moultrie Game Management Area		X		X		X
Santee National Wildlife Refuge				X		
Santee-Cooper Game Management Area	X	X		X		X
Hatchery Game Management Area		X		X		X
Francis Marion National Forest	X			X		X
Little Ocean Bay National Natural Landmark	X			X		
Guilliard Lake Natural Area, National Natural Landmark	X			X		
Little Wambaw Swamp Area, National Natural Landmark	X			X		
Hampton Plantation State Park		X			X	
Santee Delta Game Management Area		X		X		X
Santee Coastal Reserve Game Manage- ment Area		X		X		X

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>SOUTH CAROLINA (cont'd)</u>						
Cape Romain National Wildlife Refuge/ Cape Romain Wilderness*	X			X		
Bushy Park		X		X		X
Cypress Gardens			X	X		
Bull Island Natural Area		X		X		
Four Holes Swamp Wilderness Area		X		X		
Coast Experiment Station			X	X		
Givhans Ferry State Park		X		X		X
Colleton State Park		X				X
Fort Sumter National Monument	X				X	
Middleton Gardens			X	X		
Mateeba Gardens			X	X		
Edisto Beach State Park		X				X
Bear Island Game Management Area		X		X		X
Hunting Island State Park		X				X
Saint Phillips Island National Natural Landmark	X			X		
The Island Wildlife Preserve			X	X		
Pinckney Island National Wildlife Refuge	X			X		
Cypress Creek Game Management Area		X		X		X
Palachuola Game Management Area		X		X		X
Webb Game Management Area		X		X		X
Turtle Island Game Management Area		X		X		X
Tybee National Wildlife Refuge	X			X		

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>SOUTH CAROLINA-GEORGIA</u>						
Savannah National Wildlife Refuge	X			X		
<u>GEORGIA</u>						
Fort Pulaski National Monument	X				X	
Skidaway Island State Park		X				X
Wassaw Island National Wildlife Refuge	X			X		
Ossabaw Island State Heritage Preserve		X		X		
Richmond Hill State Park		X				X
Harris Neck National Wildlife Refuge	X			X		
Blackbeard Island National Wildlife Refuge/Blackbeard Island Wilderness	X			X		
R.J. Reynolds State Wildlife Refuge		X		X		
Sapelo Island National Estuarine Sanctuary	X			X		
Sapelo Island Natural Area		X		X		X
Lewis Island Natural Area		X		X		X
Altamaha State Waterfowl Management Area		X		X		X
Wolf Island National Wildlife Refuge/ Wolf Island Wilderness*	X			X		
Brunswick Pulp and Paper Company Public Hunting Area		X		X		X

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
<u>GEORGIA (cont'd)</u>						
Fort Frederica National Monument	X				X	
Jekyll Island State Park Authority		X				X
Cumberland Island National Seashore	X					X
Crooked River State Park		X				X
Santa Maria State Park		X				X
<u>FLORIDA</u>						
Nassau Wildlife Management Area		X		X		X
Fort Clinch State Park Aquatic Preserve		X		X		X
Fort Clinch State Park		X			X	X
Nassau River-Saint Johns River Marshes Aquatic Preserve		X		X		
Little Talbot Island State Park		X				X
Kingsley Plantation Historic Memorial		X			X	
Yellow Bluff Fort Historic Memorial		X			X	
Fort Caroline National Memorial	X				X	
Guana River Wildlife Management Area		X		X		X
Castillo de San Marcos National Monument	X				X	
Anastasia State Park		X				X
Frank B. Butler State Park		X				X
Fort Matanzas National Monument	X				X	
Ravine Gardens State Park		X				X
Pellicer Creek Aquatic Preserve		X		X		

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance		
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational
FLORIDA (cont'd)						
Faver-Dykes State Park		X				X
Washington Oaks Gardens State Park		X				X
Flagler Beach State Park		X				X
Bulow Plantation Ruins Historic Memorial		X			X	
Tomoka Marsh Aquatic Preserve		X		X		
Tomoka State Park		X				X
New Smyrna Sugar Mill Historic Memorial		X			X	
Turtle Mound Historic Memorial		X			X	
Mosquito Lagoon Aquatic Preserve		X		X		
Canaveral National Seashore	X			X		X
Merritt Island National Wildlife Refuge	X			X		
Saint Johns National Wildlife Refuge	X			X		
Banana River Aquatic Preserve		X		X		
Indian River-Malabar to Sebastian- Aquatic Preserve		X		X		
Sebastian Inlet State Park		X				X
Pelican Island National Wildlife Refuge/Pelican Island Wilderness	X			X		
Indian River-Vero Beach to Fort Pierce-Aquatic Preserve		X		X		
Pepper Beach State Park		X				X
Fort Pierce Inlet State Park		X				X

continued

Table 12 (continued).

Name	Ownership/Administration			Special significance			
	Federal	State	Private/ Local	Natural/ Ecological	Historic/ Cultural	Recreational	
<u>FLORIDA (cont'd)</u>							
Jensen Beach to Jupiter Inlet Aquatic Preserve		X		X			
North Fork, Saint Lucie Aquatic Preserve		X		X			
Hobe Sound National Wildlife Refuge	X			X			X
Jonathan Dickinson State Park		X					
Loxahatchee River-Lake Worth Creek Aquatic Preserve		X		X			
Loxahatchee National Wildlife Refuge	X			X			
Hugh Taylor Birch State Park		X					X
John U. Lloyd Beach State Park		X					X
Biscayne Bay Aquatic Preserve		X		X			X
Bill Baggs Cape Florida State Park		X		X			X
Biscayne National Monument	X			X			X
John Pennekamp Coral Reef State Park		X		X			X

concluded

## 6.2 RESOURCES OVERVIEW

The following paragraphs summarize the various species in the South Atlantic Zone. Only the more important species of the zone have been shown on the inventory maps due to scale limitations.

### 6.2.1 Species With Special Status

Fifty-eight state and Federally listed threatened or endangered species occur in the South Atlantic Zone (table 13). These species include five plants, two fish, twelve reptiles, one amphibian, twenty-two birds, seven marine mammals, and nine land mammals. Table 13 also summarizes the status of those species with distributions that were sufficiently documented to be mapped. State-listed species are given only when they are not superseded by a Federal designation. Many of these species occur in the Middle Atlantic Zone and have been discussed previously in this report. Several widely distributed endangered species are particularly important in the South Atlantic Zone. A brief description of their life histories is presented below.

The loggerhead turtle (202) is the most common sea turtle in the South Atlantic Zone, and it can be found mainly during the late spring and summer in ocean waters, bays, marshes, or rivers. Mating pairs migrate inshore in March and April. Nesting may occur on the sand or soil of the ocean beaches throughout the zone; significant sites in the northern portion of this zone are occupied from mid-May to mid-August and in Florida from May to September. The female loggerhead turtle nests nocturnally at intervals of 2 or 3 years, often returning to the same beach. During the breeding season, a turtle may lay from two to five clutches, each clutch consisting of 70 to 150 eggs; incubation takes from 12 to 55 days. After the nesting season, most of the population disperses.

The green sea (201) and leatherback (205) turtles also nest in the South Atlantic Zone, but these species, as well as the Florida manatee (251), are found mostly in Florida. The green sea turtle may nest only every 2 to 3 years during May through August; seven clutches may be laid in 1 year, with each clutch containing an average of 134 eggs. The leatherback turtle also nests every 2 to 3 years; nesting occurs from April to July. Six clutches may be laid in a season, and each clutch usually consists of from 80 to 85 eggs.

The Florida manatee prefers warm sluggish rivers, shallow estuaries, and saltwater bays. In the winter, it is confined to the southern half of Florida. No well-defined breeding season occurs; manatee calves are born and nursed in the water. The manatee reproductive rate is one calf per adult female every 2 to 2.5 years.

The primary breeding populations of the bald eagle (505) in the South Atlantic Zone are in South Carolina and Florida, although individuals migrate and winter along the entire southeast coast. The numbers of bald eagles have been reduced in Florida due to the heavy use of pesticides and the removal of loblolly pine trees, which are the preferred nesting trees along coastal lakes, rivers, and shores.

The peregrine falcon (507) is a Federally endangered species which migrates along the coastal areas of this zone, and it is particularly prominent along

Table 13. Species with special status in the South Atlantic Zone.

Map No.	Species	Federal		State	
		Endangered	Threatened	Endangered	Threatened
<u>FISH</u>					
110	Shortnose sturgeon	X			
111	Atlantic sturgeon			VA	FL
<u>AQUATIC AMPHIBIANS AND REPTILES</u>					
201	Green sea turtle	X			
202	Loggerhead sea turtle	X			
203	Hawksbill turtle	X			
204	Atlantic ridley turtle	X			
205	Leatherback turtle	X			
<u>MARINE MAMMALS</u>					
251	Florida manatee	X			
257	Right whale	X			
	Sei whale	X			
	Humpback whale	X			
	Blue whale	X			
	Fin whale	X			
	Sperm whale	X			
<u>PLANTS</u>					
302	Spleenwort				GA
303	Spider lily			GA	
304	Pond bush				GA
305	Watermilfoil				GA
306	Hooded pitcher plant				GA
<u>BIRDS</u>					
406	Least tern				FL
407	Roseate tern				FL
416	American oystercatcher				FL
438	Wood ibis (Wood stork)			FL	
440	Little blue heron*				
443	Florida sandhill crane				FL
444	Louisiana heron*				

\*Species of "special concern"; legally protected in Florida.

continued

Table 13 (continued).

Map No.	Species	Federal		State	
		Endangered	Threatened	Endangered	Threatened
<u>BIRDS (cont'd)</u>					
445	Limpkin*				
446	Roseate spoonbill*				
447	Snowy egret*				
448	Magnificent frigate bird				FL
449	Reddish egret*				
505	Bald eagle	X			
506	Osprey				FL
507	Peregrine falcon	X			
511	Southeastern American kestrel				FL
512	Florida burrowing owl*				
535	Brown pelican	X			
552	Red-cockaded woodpecker	X			
554	Bachman's warbler	X			
565	Dusky seaside sparrow	X			
566	White-crowned pigeon				FL
<u>TERRESTRIAL AMPHIBIANS AND REPTILES</u>					
602	Eastern indigo snake		X		
603	American alligator	X	X		
608	Gopher tortoise			SC	FL
616	Florida gopher frog			FL	
617	Atlantic salt marsh watersnake		X	FL	
618	American crocodile	X	X		
619	Florida Keys mole skink				FL
620	Miami black-headed snake			FL	
<u>TERRESTRIAL MAMMALS</u>					
717	Black bear				FL
735	Pallid beach mouse			FL	
736	Sherman's fox squirrel				FL
737	Florida mouse				FL
738	Florida panther	X			
739	Goff's pocket gopher			FL	
740	Key Largo wood rat			FL	
741	Lower keys cotton rat				FL
742	Key Largo cotton mouse			FL	

concluded

high-energy beaches. This species is not known to breed in the South Atlantic Zone.

The brown pelican (535) ranges from North Carolina to south Florida; it prefers to nest in large colonies on sandy beaches or in trees and shrubs.

Coastal plain pinewoods of the southeastern United States are the preferred habitats of the endangered red-cockaded woodpecker (552); it inhabits mature southern pine forests, particularly those dominated by longleaf pine. The red-cockaded woodpecker is widely distributed in the South Atlantic Zone, although it is not as prominent in the Biscayne Bay section. South Carolina, Georgia, and northern Florida presently have the highest populations of this species.

The American alligator (603) lives in freshwater rivers, swamps, and marshes throughout the southern half of the South Atlantic Zone.

The American crocodile (618) is found in North America only in extreme southern Florida. The crocodile is found primarily in coastal swamps and rivers, where females often use the same nesting mounds for several years. Nest preparation takes place in April, and 20 to 80 eggs are laid in late April or early May. The young usually hatch by early August, but, in the Florida Bay area, for example, only 50 percent of the nests are successful. The other eggs fail to hatch each year due to predation or low nest temperatures.

#### 6.2.2 Aquatic Resources

The estuaries of the South Atlantic Zone are not as extensive as some of those in the Middle Atlantic Zone, but they occur in greater numbers. The numerous marshes in the zone contribute to the great diversity and abundance of aquatic organisms along the South Atlantic coast.

Brief descriptions of the life histories of the major commercially, recreationally, and ecologically important aquatic organisms which occur within the South Atlantic Zone are provided below. This summary discusses those species which were not covered previously in the Resources Overview parts of the North and Middle Atlantic Zones (parts 4.2 and 5.2).

##### Invertebrates

Shellfish, such as oysters, bay scallops, and hard and soft clams, complete their entire life cycles within the estuaries of the South Atlantic Zone. The bay scallop is an important South Atlantic Zone fishery because it provides an annual harvest; it spawns in the fall and is harvested the following winter.

Shrimp and blue crab are the most economically valuable fishery species in the zone. Shrimp is the most important commercial fishery in the South Atlantic Zone. White and brown shrimp comprise a majority of the catch throughout most of the zone except in North Carolina where pink and brown shrimp are the major species. All three species spawn offshore in ocean waters, but white shrimp sometimes spawns nearshore. White and pink shrimp spawn from mid-spring to fall; the juveniles move into the South Atlantic Zone estuaries from late spring through the fall. Brown shrimp spawns during the late fall and winter and the juveniles then enter the estuaries during the winter and early spring. Juveniles

of all three species use the shallows, marshes, and seagrass beds of the low-salinity portions of the estuaries as nursery areas; when mature, they gradually move to the more saline portions of the estuaries. A portion of the juvenile white and pink shrimp populations may overwinter in the estuaries and then spawn offshore the following spring as adults. Brown shrimp moves offshore to spawning grounds during the fall. Because of this rapid life cycle, shrimp is an important annual crop in the South Atlantic Zone. Shrimp harvesting occurs mainly from May through December; the peak period is from July through October.

Two important tropical species are the spiny lobster and stone crab. The spiny lobster is common in southern Florida waters of the South Atlantic Zone. This species is usually found in 1.5 to 12 meters (5 to 40 feet) of water during the late summer and fall. It is caught out to 55 meters (180 feet) off the Florida Keys and is the most valuable fishery of that area. Juveniles are found nearshore in grassy areas and under rocks and sponges. As they mature, they move into deeper water where they live among rocks, coral reefs, and large sponges.

The stone crab is found in southern Florida in a variety of habitats; young crabs live in shoreline rubble and on pilings, and adults reside in burrows in shallow bays, marshes, and ocean waters. The stone crab is fished from October through May. Only the claws of this species generally are harvested; these claws can be regenerated by the stone crab.

### Fish

a. Freshwater species. Freshwater species, including catfish and bullhead, white bass, and numerous sunfish (redbreast, bluegill, warmouth, largemouth bass, and black crappie), occur in the upper reaches of tidal estuaries, in nontidal rivers, and in lakes.

Sunfishes are a major freshwater family of the upper tidal and nontidal freshwater rivers of the South Atlantic Zone. These species are of major recreational importance, and they are found in a variety of habitats including rivers, ponds, and reservoirs. From spring to mid-summer, the sunfish constructs its nest, spawns, and then guards the nest until the young hatch. Similarly, catfish and bullhead, including the white and channel catfish and brown, yellow, and flat bullhead, are found in a variety of freshwater habitats. These fish also construct nests, spawn, and remain at their nests during the spring and early summer. These species are of large recreational importance and comprise the major freshwater commercial fishery in the South Atlantic Zone.

b. Anadromous species. Anadromous fishes in the South Atlantic Zone are similar to those of the Middle Atlantic Zone, but differ in their distributions. The hickory shad, for example, is common throughout the South Atlantic Zone; however, the alewife is not abundant south of South Carolina. Hickory shad migrate from nearshore ocean waters and lower estuaries to spawn in tidal freshwater during April through June. The adults return to the ocean shortly after spawning, but the juveniles emigrate from the upper estuarine nursery grounds in the early summer.

Spawning migrations of several South Atlantic Zone anadromous species begin earlier in the year than those of Middle Atlantic Zone species. Striped bass, white perch, American shad, hickory shad, blueback herring, alewife, and

Atlantic sturgeon migrate from the ocean or lower estuaries to spawn in fresh and brackish water rivers of the South Atlantic Zone in the spring. Juveniles of these species use the estuaries as nursery areas.

c. Estuarine-dependent species. Species such as Atlantic menhaden, weakfish, spotted seatrout, spot, Atlantic croaker, southern, northern, and gulf kingfish, silver perch, red and black drum, bluefish, summer and southern flounder, and striped and white mullet use the estuaries extensively as spawning, nursery, or feeding grounds, but also are found as adults along the Continental Shelf. These estuarine-dependent species comprise a majority of the ecologically, recreationally, and commercially important fishery within the South Atlantic Zone. Menhaden ranks third in economic value in the zone, but it is first in terms of volume yield.

The drum family is the dominant estuarine-dependent group of the South Atlantic Zone; its major representatives are spot, Atlantic croaker, weakfish, spotted seatrout, southern and gulf kingfish, and red and black drum. The spotted seatrout has a life history similar to that of the weakfish. It spawns from mid-spring through the summer in lower estuaries, deep channels, and near-shore ocean waters. Spotted seatrout juveniles develop in tidal river nursery areas and gradually move downstream as they mature. Adults inhabit both inshore and estuarine waters in the spring through fall but swim offshore during the winter in the northern part of the zone and reside in estuaries throughout the year in Florida. The southern and gulf kingfish spawn mainly offshore from mid-spring through summer. Juvenile southern kingfish mature in estuaries and the coastal surf zone in shallow water, while juvenile gulf kingfish prefer the shallow, open surf of the ocean. Similarly, adult southern kingfish inhabit high-salinity areas, estuaries, and ocean surf and the gulf kingfish is found mainly along the ocean beach. Both of these species tend to move into deeper waters during winter.

In the northern section of the zone, black drum spawns along the ocean coast and estuarine waters during spring while in the southern section, spawning occurs during the winter. The juveniles occupy the upper reaches of bays and tidal creeks and move to deeper waters when they mature. Adults generally are found on sandy bottoms along the coast and in the lower part of the estuaries from spring to early winter, but they move to deep oceanic water during the winter.

Adult red drum is found close to shore and in the lower portion of estuaries during the spring through mid-fall and spawns in nearshore coastal waters during the fall and early winter. Juveniles mature in estuaries in shallow, quiet water. Red drum overwinter in deep ocean waters, and adults spend the greater portion of the year offshore.

The southern and summer flounder are the most common commercial and recreational flounders in the South Atlantic Zone. Southern flounder spawns offshore during the fall and winter and migrates inshore and into the bays during spring. Juveniles mature in the estuaries throughout the year.

Striped and white mullet are two of the more abundant and widespread species in the South Atlantic Zone. They occupy shallow freshwater and saltwater areas from spring to fall; striped mullet is more abundant in the northern sections of the zone than white mullet. Adult mullet migrates offshore in fall and spawns on

the Continental Shelf during the winter. Juvenile and adult mullet arrive inshore in the spring; both groups inhabit estuaries and ocean beaches.

d. Oceanic species. Many commercially and recreationally important pelagic species occasionally occupy the lower, high-salinity parts of the estuaries, especially as juveniles. Adults are most often found in coastal waters where they use estuarine-dependent species as a food. These species include the temperate-water black sea bass and scup and the tropical tarpon, pompano, Spanish and king mackerel, little tunny, sailfish, jack, snapper, grouper, cobia, pigfish, white grunt, snook, and ladyfish. Most of these species occur in the northern portion of the zone from spring through fall and occupy Florida waters year-round. Many juvenile tropical species use the lagoonal waters along the Florida coast as nursery areas during the summer.

Pompano and tarpon are two tropical marine species of significance in the zone, particularly because of their recreational importance. Adult pompano usually is found near inlets and along sandy beaches; they are more abundant in the southern section of the zone. During the spring and summer, the species tends to spread northward along the entire south Atlantic coast, at which time it spawns, probably in the offshore environment. The juveniles move inshore and are found along low-energy ocean and lower estuarine beaches throughout the summer. In the fall, as the waters cool, the species moves southward and offshore. The adult tarpon is usually found in estuaries or within a few miles of land. Tarpon spawns during the late spring and summer, but where it spawns is not known. Tarpon larvae are found throughout the estuaries, young juveniles occur mainly in shallow pools and small tidal creeks. As the juveniles increase in size, they move toward the Atlantic Ocean.

The king and Spanish mackerel spawn offshore from mid-spring to early fall. The young of both species occur close to shore, and juvenile Spanish mackerel also occupy lagoonal nursery grounds. Spanish mackerel adults occur inshore while the king mackerel generally is found farther offshore. Both species prefer high-relief, rocky, or coral habitats.

The little tunny spawns offshore from February through November; it is found at water depths ranging from 18 to 61 meters (60 to 200 feet) during April through August. Little tunny prefers rocky or coral habitat.

The sailfish concentrates off Florida during November through February, but migrates north and spawns during the spring and summer.

Snappers, including the lane, silk, mutton, gray, vermilion, red, and yellowtail, are a high-relief, hard bottom family. These species spawn during the summer in rock and coral habitats. The juveniles move inshore and into the lagoonal nursery areas. Although they are fished all year, the best fishing is generally in the spring and fall.

Groupers, including the gag, the speckled hind, and the Nassau, the black, red, and warsaw grouper, and the jewfish, are bottom species usually found on rock and coral substrates off Florida. These fish are hermaphroditic and generally spawn offshore; the young fish tend to occur inshore, although they move offshore as they mature.

Additional information on life histories of various species can be obtained from the report Development of Fishes of the Mid-Atlantic Bight (U.S. Department of Interior (DOI), 1978). Data on commercial fisheries is updated in Current Fisheries Statistics for the appropriate states and published by the U.S. Department of Commerce, National Marine Fisheries Service.

### 6.2.3 Terrestrial Resources

A distinctive feature of much of the South Atlantic Zone is the large barrier island estuary, consisting of a series of dunes with a wide band of salt marsh between the outer barriers and the mainland. These estuaries contain numerous tidal creeks and sounds and algal-rich mudflats. Inland areas consist of pine forests, scattered grasslands, and upland hardwoods. Baldcypress and water tupelo dominate riverine communities. Marshes, rivers, and forests constitute some of the more valuable wildlife areas in the zone.

The diversity of wildlife associated with the various habitats in the South Atlantic Zone is large. The greatest concentrations of upland wildlife are found in areas that are refuges from hunting and that have restricted public access. The variety of wildlife in the South Atlantic Zone includes herons, egrets, and other waterbirds, ospreys, hawks, clapper rail, turkeys, numerous waterfowl, small birds, whitetail deer, squirrels, rodents, and endangered wildlife species such as the bald eagle, brown pelican, and alligator.

#### Birds

The avian population is the most conspicuous segment of the wildlife community of the South Atlantic Zone. The zone is a major migratory route for many birds. Waterbirds, waterfowl, and shorebirds traverse the zone in large numbers during spring and fall. Freshwater ponds are used extensively by several species of waterbirds for nesting, feeding, and resting, and the ponds also attract wood ducks and other waterfowl, turkey, deer, and squirrels.

a. Shorebirds. Large numbers of shorebirds nest in this zone, mainly on the isolated islands, spoil banks, and remote or protected beaches. Some of the common colonial nesting shorebirds are laughing gulls, herring gulls, ring-billed gulls, common terns, royal terns, black skimmers, sandwich terns, and Forster's terns. The American oystercatcher and Wilson plover nest along the coastline.

Shorebirds migrate north from mid-April to mid-May and arrive in the South Atlantic Zone from early August to mid-October; in southern sections of the zone, shorebird flights start a week earlier in spring and the birds arrive a week later in fall. Gulls, terns, and skimmers nest in bare sandy areas where they lay from one to four eggs. Colony sites often are used as resting and roosting areas prior to migration.

b. Wading birds. Wading birds nest in large colonies in the freshwater marshes and saltwater bays. This group includes the great egret, cattle egret, snowy egret, Louisiana heron, black-crowned night heron, glossy ibis, and white ibis. These birds usually occupy dense thickets of shrub and low trees. Most species lay from one to five eggs per clutch, and birds start nesting during late March to early April. Most of these birds migrate to more southern sections of

the Atlantic coast in winter. The greatest abundance of cattle egret in the United States occurs in the South Atlantic Zone. Brown pelicans nest in the southern section of the zone.

c. Waterfowl. The establishment of wildlife refuges in the zone has greatly benefited migrating waterfowl of which the most common species are the Canada goose, lesser scaup, pintail mallard, black duck, canvasback, redhead, and ring-necked duck. Mallard and black duck populations have declined due to excessive hunting. The open estuaries and marshes are used by migratory waterfowl in the winter for feeding and resting.

Peak flights for waterfowl occur from mid-February to the end of March and from late October to mid-December.

d. Raptors. Raptors found within the South Atlantic Zone include vultures, kites, and owls, which are common predators that nest along the coast. The swallow-tailed kite is restricted to the southern sections.

e. Seabirds. Large numbers of seabirds such as petrels, shearwaters, gannets, and jaegers, annually migrate just offshore along the southeast coast.

f. Songbirds and others. Hardwood uplands harbor large populations of small songbirds and a substantial population of pileated woodpeckers. Popular upland game birds are the bobwhite, turkey, and mourning dove.

Groups of migrating songbirds are not as large as groups of other birds, because few wide river valleys or other topographic features exist in the South Atlantic Zone to channel their movement as compared to the Middle Atlantic Zone. Migrations peak during late March to early May and from early September to early November; however, in the southern sections of the South Atlantic Zone, flights start a week earlier in spring and the birds arrive a week later in fall.

#### Mammals

Upland pine-hardwood stands support large populations of deer and gray squirrel and some black bear. Furbearers common throughout the zone are raccoon, opossum, red and gray fox, mink, otter, bobcat, and beaver.

### 6.3 PAMLICO SOUND COMPLEX (GRID REFERENCE VR16 TO UP63)

The Pamlico Sound Complex extends from south of Cape Henry, Virginia, to Cape Lookout, North Carolina, and consists of a series of sounds which are protected behind long barrier islands with few inlets from the ocean. The important sounds, which include Currituck, Albemarle, Pamlico, and Core Sounds, are fed by numerous coastal plain rivers, the larger of which are the Chowan, Roanoke, Alligator, Pamlico, Tar, and Neuse Rivers. The entire sound complex is an estuary with salinities increasing from freshwater, in the rivers and Currituck Sound, to seawater at the ocean inlets. The biotic resources of this section are keyed geographically using east-west UTM grid swaths.

## Aquatic Resources

a. Widespread species. Expansive tidal marshes and seagrass beds rim the estuarine complex and contribute a large amount of nutrients and energy to the system. Eelgrass is the main seagrass species, especially from Beaufort to Morehead City, and it is often replaced in the winter by shoalgrass.

Several shellfish which occur throughout the Pamlico Sound Complex are commercially important. These shellfish include brown, white, and pink shrimp, and blue crab.

The Pamlico Sound Complex contains an abundance of finfish species because of its diverse habitats and high-nutrient and high-energy input. Within the freshwater portions of the Pamlico Sound Complex, several catfish, sunfish, and bass species constitute an important commercial and sport fishery.

Several anadromous species within this section are fished both commercially and recreationally during their spring spawning migrations. These species include the American shad, alewife, blueback herring, hickory shad, striped bass, and Atlantic sturgeon. Alewife is the most abundant species from Pamlico Sound and north, whereas blueback herring is most abundant to the south. The shortnose sturgeon, a Federally endangered anadromous species, is believed to inhabit the Pamlico Sound Complex.

Several estuarine or estuarine-dependent commercially important species which occur throughout the Pamlico Sound include brown, white, and pink shrimp, blue crab, oyster, Atlantic menhaden, Atlantic croaker, spot, weakfish, spotted seatrout, white perch, bluefish, summer and southern flounder, striped and white mullet, and American eel. Although these species either spawn in the ocean or within sounds and rivers, their juveniles use the shallows, marshes, and seagrass beds of the low-salinity portions of the estuaries as nursery areas. North Carolina has designated several areas as primary nursery grounds where it is unlawful to use trawl nets or dredges to catch fish. Primary nursery grounds are defined as those areas where initial postlarval development occurs, and they generally are located in low-salinity estuaries where populations uniformly consist of early juvenile forms. The boundaries of these numerous areas are described in "North Carolina Fisheries Regulations for Coastal Waters" (North Carolina Department of Natural Resources and Community Development, 1980).

b. Geographic inventory. Lake Drummond (grid reference UR65), in the northern drainage basin of the Pamlico Sound Complex, is part of the Great Dismal Swamp and contains numerous species of catfish, sunfish, and bass. Lake Drummond is an especially significant area because it harbors a habitat for the rare swampfish.

Currituck Sound (grid reference VR13 to VR30) contains numerous species of catfish, sunfish, and bass which are similar to those found in Lake Drummond.

Albemarle Sound and its tributaries, the Chowan, Roanoke, Perquimans, Little, Pasquotank, and Alligator Rivers (grid reference VR03 to VQ24 and west), are major summer concentration areas for several estuarine-dependent species such as bluefish, spot, Atlantic croaker, weakfish, spotted seatrout, southern

flounder, and blue crab. These species are significant recreational and commercial resources.

The Albemarle Sound system also is of major importance because anadromous species use it to spawn and mature. The upper Roanoke (grid reference TQ99) and Meherrin (grid reference UR23) Rivers are major striped bass spawning streams in the South Atlantic Zone. Blueback herring, alewife, hickory and American shad, striped bass, and white perch also concentrate in these rivers during their spring spawning runs, and they support an active commercial and recreational fishery. Almost 75 percent of the North Carolina striped bass fishery, and nearly all of the white perch fishery, take place in Albemarle Sound.

Pamlico Sound (grid reference VQ56 to UP97 and west) is primarily a high-salinity estuary. Extensive ruppia beds are found in Pamlico Sound. Oysterbeds, many of which are seeded, rim the mainland side in the shallows. The brown, pink, and white shrimp, the most valuable fishery in the state, also are harvested to a large extent in Pamlico Sound in the summer and fall. Brown shrimp generally comprises 66 percent of the North Carolina catch, pink shrimp comprises 25 percent, and white shrimp comprises the remainder. Commercial concentrations of numerous estuarine-dependent species, including blue crab, bluefish, Atlantic croaker, spot, weakfish, spotted seatrout, and summer and southern flounder, are located on the seaward side of the sound. Several threatened and endangered sea turtles occasionally are found inside the sound, including the green, loggerhead, and Atlantic ridley turtles.

The Pamlico (grid reference UQ61 and upstream) and Neuse (grid reference UP68 and upstream) Rivers which empty into Pamlico Sound provide spawning and nursery grounds for the four major herring and shad species. The Neuse River is an important sport fishing area for herring and shad, especially the hickory shad.

Core Sound (grid reference UP87 to UP64) forms the southern border of the Pamlico Sound Complex and is a high-salinity estuary. Core Sound provides a major habitat for bay scallop, hard clam, and oyster. The bay scallop fishery in Core and Bogue Sound to the south (see subsection 6.4.2) is one of the more important fisheries in the South Atlantic Zone. The major commercial concentrations of menhaden and striped and white mullet within the Pamlico Sound Complex also are harvested in Core Sound. Menhaden, the highest volume fishery in North Carolina, is fished in Core Sound from April through September. Thread herring often is caught with the menhaden and is an important part of the fishery.

### Terrestrial Resources

In the coastal area of Pamlico Sound, the major habitat types occur in portions of the tidewater and the inner coastal plain. The tidewater area consists of a series of peninsulas, estuaries, and tidal basins and lakes. Freshwater marshes also abound, which contain cattail, bulrush, and sawgrass as the dominant species. Black needlebrush dominates the numerous salt marshes which border the Pamlico Sound Complex.

The inner coastal plain is characterized by Carolina Bays and forested areas containing such species as baldcypress, white cedar, sweetgum, ash, and bay. Numerous wooded swamps, locally known as pocosins, are scattered throughout the section.

a. Widespread species. The tidal creeks provide protective and isolated areas and food for large concentrations of migratory species, particularly shorebirds, waterfowl, and other waterbirds. The common species are gulls, terns, skimmers, egrets, herons, and snow geese.

b. Geographic inventory. A unique natural area in the northern portion of the Pamlico Sound section is the Great Dismal Swamp (grid reference UR76 to UR73). Several cypress trees in the Great Dismal Swamp are estimated to be at least 1,500 years old. Approximately 88 species of birds nest in the swamp, and at times large flights of up to 10,000 pine siskins and 1 million robins have been sighted. During the winter, millions of blackbirds roost in trees near the Virginia-North Carolina border. Many mammal species inhabit this area (black bear, deer, bobcat, mink, otter, and gray fox), and bird life is particularly abundant.

The Currituck Banks area (grid reference VR25 to VR22), in the general locale of Mackay Island, attracts about 15 percent of the waterfowl in the Atlantic flyway during the fall, winter, and spring. These banks also are an important habitat for many other plant and animal species.

Back Bay National Wildlife Refuge (grid reference VR15) is characterized by beach, dunes, brackish marshes, and waters near the mouth of the Chesapeake Bay. These ecosystems provide a haven for thousands of transient and wintering waterfowl and migrating shorebirds. Winter bird populations are smaller than populations in the spring or fall. In recent years, record populations have been reported for a number of species, including gannets, red-throated loons, whistling swans, snow geese, gadwall, Forster's tern, jaegers, and Swainson's thrushes. In late November, as many as 20,000 whistling swans may fly over the refuge in a two-day period; several thousand swans also stop over for short periods of time.

At nearby Mackay Island National Wildlife Refuge (grid reference VR14), seasonal concentrations of waterfowl include hundreds of canvasbacks, thousands of American widgeons, and 40,000 American coots.

The Dare Game Land and Bear Sanctuary (grid reference VQ28 to VQ23) provides habitat for many game animals and is the northernmost limit in the United States for the American alligator. Within the game lands, this reptile inhabits Mill-tail and Whipping Creeks and the Alligator River.

Pungo National Wildlife Refuge (grid reference UQ55 to UQ54), to the west, is a wintering area for some 30,000 Canada geese, thousands of snow geese and whistling swans, and 12 different duck species. Wood ducks nest here and produce as many as 400 young annually.

One-fifth of the North American population of whistling swans typically spend the winter at Mattamuskeet National Wildlife Refuge (grid reference VQ03 to UQ82), which contains North Carolina's largest natural lake. The concentrations of swans, geese, and ducks are as large here as anywhere in the southeastern United States. The shallow waters of this lake provide ideal feeding grounds for all types of waterfowl. More than 100,000 ducks, comprising over 12 common South Atlantic Zone species, frequent this large freshwater body. The endangered bald

eagle and peregrine falcon also frequent this area in winter, and scores of osprey nest on the western end of the lake. Small numbers of the endangered red-cockaded woodpecker also nest here in mature loblolly pine stands.

Swanquarter National Wildlife Refuge (grid reference UQ91 to UQ72), bordering Pamlico Sound, is an important habitat for wintering waterfowl, and contains a larger number of diving ducks than Mattamuskeet. This area, representing one of the northernmost habitats for the American alligator, also is host throughout the year to red-cockaded woodpeckers. Bald eagles and peregrines occupy this area in winter.

Although beavers are not abundant in the coastal area of Pamlico Sound, they are commonly found between grid references UP59 and UP39.

Cedar Island National Wildlife Refuge (grid reference UP77 to UP76) is a significant black duck nesting area. The refuge is an important feeding, nesting, and breeding area for waterbirds. Nesting birds include over 400 pairs of herons, up to 2,000 roseate terns, 500 laughing gulls, and 100 Forster's terns. This area is recognized as a potential breeding area for the endangered brown pelican, which rarely breeds in North Carolina.

#### 6.4 VIRGINIA-CAROLINA COAST (GRID REFERENCE VR18 TO PG67)

The Virginia-Carolina Coast section encompasses the exposed outer coast from Cape Henry, Virginia, to Winyah Bay, South Carolina. The Virginia-Carolina Coast has been divided into two subsections: the Seaward Shore, Cape Henry to Cape Lookout, and Cape Lookout to Winyah Bay. The biotic resources for this section are keyed geographically using east-west UTM grid swaths.

##### 6.4.1 Seaward Shore, Cape Henry to Cape Lookout (Grid Reference VR18 to UP52)

The seaward shore of the Pamlico Sound Complex, extending from Cape Henry, Virginia (grid reference VR18), to Cape Lookout, North Carolina (grid reference UP52), is characterized by a series of long, narrow islands, which are occasionally interrupted by inlets. This section of the south Atlantic coast is known as the Outer Banks.

##### Aquatic Resources

The Outer Banks are a transition zone between temperate fish species of the Middle Atlantic Zone and those of the subtropical sections of the southern South Atlantic Zone. Thus, this subsection consists of waters with a mixture of temperate Middle Atlantic Zone species and several tropical migrants.

a. Widespread species. Many oceanic, estuarine-dependent, and anadromous species occur along this coastal section. Fish and shellfish tend to concentrate in several localities on this coast; these areas are used intensively for commercial and recreational purposes. Many tropical species occur in the warm offshore waters of the Gulf Stream, which veers away from the south Atlantic coast between Cape Lookout and Cape Hatteras.

Shrimp and menhaden are the two most valuable commercial fisheries in North Carolina; brown, pink, and white shrimp are harvested from July through November.

Brown shrimp and pink shrimp comprise over 90 percent of the catch. Menhaden is fished mainly from April through January.

The coastal waters from Cape Henry to Cape Lookout provide a habitat for six threatened or endangered whales, five sea turtles, and one fish during spring and fall migrations (see subsection 6.2.1).

b. Geographic inventory. The locality north of Cape Hatteras (grid reference VR18 to VP59) is a major winter trawl area for summer and southern flounder and black sea bass as well as a spring trawl area for scup. Portions of this northern reach, from approximately the Dare-Currituck county line (grid reference VR30) to Oregon Inlet (grid reference VQ55), and at Cape Hatteras (grid reference VP59), also are significant commercial grounds for striped bass, weakfish, spotted seatrout, spot, and bluefish.

The main fishing ground for croaker, menhaden (combined with thread herring), and shrimp is the area extending from Cape Hatteras to Cape Lookout (grid reference VP59 to UP52). The loggerhead turtle nests along a large portion of this coast from approximately 16 kilometers (10 miles) south of Oregon Inlet (grid reference VQ54) to Cape Lookout (grid reference UP52). Cape Lookout is one of the three turtle nesting concentration areas in North Carolina; these three areas comprise about 80 percent of the turtle nesting population in the state. In addition, king mackerel tends to concentrate at Cape Lookout (grid reference UP52), seaward of the 18-meter (60-foot) contour.

#### Terrestrial Resources

Along the seaward shore of the Virginia-Carolina Coast, long barrier islands provide the main terrestrial habitats. Islands in this section are characterized by minimal vegetative cover. Perennial dune grasses and maritime shrub thickets are found on most of the islands, but a few islands also contain mature forests. Salt marshes fringe the protected mainland side of the islands.

a. Widespread species. The remote and undeveloped nature of the Outer Banks attracts many wildlife species, especially birds. Waterbirds, waterfowl, and shorebirds migrate along the coast in large numbers. Most of the colonial birds which nest here are migratory, and they spend the winter farther south and return in spring.

Local populations of gulls, terns, and skimmers are generally large and are supplemented by migrants from the north. The most abundant shorebird nesters are the royal tern and laughing gull; almost 10,000 nesting pairs of each species breed annually along the seaward shore of the South Atlantic Zone. Common terns also are fairly abundant. Other important species include black skimmer, least tern, Forster's tern, sandwich tern, Wilson's plover, and American oystercatcher.

Ten species of colonial wading birds breed and nest along the seaward shore, including great egret, snowy egret, Louisiana heron, black-crowned night heron, yellow-crowned night heron, and glossy ibis.

Many waterfowl and landbird species inhabit the seaward shore during migratory periods.

b. Geographic inventory. Pea Island National Wildlife Refuge (grid reference VQ55 to VQ54) and Cape Hatteras National Seashore (grid reference VQ47 to VP08) serve as primary winter concentration areas for some 50 peregrine falcons. Pea Island is a noted wintering area for snow geese, and hosts perhaps one-half of the entire northeastern North American population of this species. The rare brown pelican also occurs in this area, which represents the extreme northern edge of the pelican's range. A large variety of shorebirds breed here, as well as several hundred wading birds. These refuges also provide a harbor for otter, muskrat, nutria, reptiles, and amphibians. As many as 500 sharp-shinned hawks have been sighted in a single day.

Buxton Woods (grid reference VQ40) contains the only maritime forest on the Outer Banks, and it is a relict of a much more extensive forest which existed in historic times. The bald eagle is an occasional winter visitor, and nesting populations of osprey, red-shouldered hawk, and swallow-tailed kite also occur here. In addition, this area contains the only significant population of white-tail deer found on the Outer Banks.

The northernmost breeding colony of brown pelicans in the eastern United States and the only breeding colony in North Carolina occurs on the Pamlico Sound Islands (grid reference VP08), where 100 to 200 adults nest from March through July. Winter and resident populations of gulls, terns, herons, and egrets also occur on these islands.

#### 6.4.2 Cape Lookout to Winyah Bay (Grid Reference UP52 to PG67)

The southern portion of the Virginia-Carolina Coast from Cape Lookout to Winyah Bay (grid reference UP52 to PG67) differs from the northern portion, because it is comprised of short barrier islands with numerous inlets. Immediately adjacent to these inlets are narrow estuarine bays and vast expanses of tidal marsh. Three large rivers, the White Oak, New, and Cape Fear Rivers, and several smaller rivers, empty into this coastal section.

#### Aquatic Resources

a. Widespread species. Several species such as oyster, hard clam, bay scallop, and blue crab are permanent residents of the bays in this subsection. These productive estuaries are also feeding, nursery, and in some cases spawning grounds for numerous important commercial and recreational fish, including menhaden, striped bass, croaker, weakfish, spotted seatrout, spot, bluefish, and mullet. Important anadromous species include Atlantic sturgeon, alewife, American shad, hickory shad, and blueback herring. These shellfish and finfish are major components of the nearshore ocean fishery.

b. Geographic inventory. Back Sound and Bogue Sound (grid reference UP53 to UP03) are major bay fishery areas for menhaden, scallop, mullet, and blue crab. Menhaden is harvested here mainly during April through September; thread herring comprises a large portion of this fishery. The bay scallop beds of these sounds together with the beds of Core Sound (grid reference UP87 to UP64) to the north represent the major bay scallop areas in the South Atlantic Zone. On the ocean side of these sounds, from Cape Lookout to Bogue Inlet (grid reference UP52 to UP03), major commercial and recreational concentrations of striped bass,

weakfish, spotted seatrout, spot, Atlantic croaker, striped and white mullet, and bluefish are found.

Menhaden concentrates in ocean waters from Cape Lookout to Cape Fear (grid reference UP52 to TN24), mainly from April through January. Black sea bass is fished from Bogue Inlet (grid reference UP03) and south throughout the nearshore area during the summer.

Several endangered or threatened species, including six whale species, five sea turtles, and one fish, are found during spring and fall migrations along the entire coast from Cape Lookout to Winyah Bay. The loggerhead turtle nests extensively during the summer along the coast from Cape Lookout to Long Beach (grid reference UP52 to QH55). Major loggerhead nesting areas are located at Cape Lookout (grid reference UP52), Hammocks Beach (grid reference UP03), and the area extending from Onslow Beach to Topsail Beach (grid reference TP92 to TP50). These areas comprise 80 percent of North Carolina's loggerhead nesting population.

The Cape Fear River (grid reference QH75 and upstream) is a spawning area for anadromous species, including Atlantic sturgeon, alewife, American shad, hickory shad, and blueback herring.

The ocean waters adjacent to Horry County, South Carolina (grid reference QH24 to PH81), provide the major South Carolina commercial fisheries for Atlantic sturgeon, bluefish, spotted seatrout, spot, and mullet.

#### Terrestrial Resources

Habitats in this subsection are similar to those found in the Pamlico Sound Complex, that is, the section is characterized mainly by forests, salt marshes, and beaches. Salt marshes are particularly well developed behind barrier islands in the southern portion. In some upland areas, forests have reverted to savannahs due to periodic fires which enhance the growth of herbaceous species. Many abandoned rice fields have reverted to marshland and provide an excellent habitat for wildlife.

a. Widespread species. The many marshes, inlets, and bays along the coast in this subsection provide excellent habitats for a variety of species. Shorebirds, wading birds, and waterfowl migrate along the coast and overwinter in many of the bays and sounds. Wild turkey is common in a broad band of upland forests paralleling the coast and several mammals, particularly deer, are recreationally important.

b. Geographic inventory. Croatan National Forest (grid reference UP18 to UP14) occupies over 123,887 hectares (306,000 acres) and provides sport hunting opportunities for a variety of game animals. This forest contains Great Lake, which has a shoreline that is considered to be one of the better localities for birds in North Carolina. Nesting birds in the forest include ospreys, herons, double-crested cormorants, and warblers.

Abundant populations of alligator, several colonies of red-cockaded woodpeckers, and nesting ospreys make the White Oak River and its marshes (grid reference TP96 to TP95) an important habitat for wildlife.

The area around Orton Pond and Plantation (grid reference TN26) is a coastal cypress pond containing a large number of American alligators. In addition, red-cockaded woodpeckers have several nesting colonies and ospreys are known to nest here. This locality also contains the only known breeding colony of anhinga in North Carolina.

The largest heronry in North Carolina is located in a well-developed maritime forest in the Bald Head-Battery-Smith Island area (grid reference TN25). Approximately 3,000 to 4,000 nests containing nine species of heron, egret, and ibis inhabit Battery Island. Habitat in this island-marsh complex is highly diverse, and supports a large variety of birds and mammals. Bald Head, in particular, is critically important to the thousands of birds that migrate along the coast. Brown pelican is a permanent resident of this marsh.

A number of significant floral species occur here. These species include rare and unique virgin tree stands and related climax communities. These species are identified by a descriptor (Tree 307) on the accompanying maps and include the following:

<u>Grid Reference</u>	<u>Feature</u>
PH84	Crapemyrtle (large specimen)
PH70	American holly (large specimen); tree baccharis and five-stamen tamarisk (large specimens)
PG69	Red buckeye (national champion)
PG58	Crown group of live oaks (group of 14 immense oaks clustered in unique crown-shaped formation)
PG58	Turkey oak (large specimen)
PG28	Carolina ash (national co-champion); hawthorn and planetree (large specimens)
PG28	Mature stand of baldcypress and water tupelo over 150 years old.

#### 6.5 SEA ISLANDS (GRID REFERENCE PG67 TO MD66)

The Sea Islands section, extending from Winyah Bay, South Carolina (grid reference PG67), to the Saint John's River in Florida (grid reference MD66) derives its name from the numerous large, irregularly shaped barrier islands which line the coast. Between these islands and the mainland is one of the larger salt marsh systems in the world. Numerous rivers and sounds empty into the marshes to form a complex series of waterways. These rivers and sounds include the Pee Dee-Waccamaw River and Winyah Bay Complex; the Santee River; Charlestown Harbor; the North and South Edisto Rivers; St. Helena, Port Royal, Calibogue, Ossabaw, St. Catherine's, Sapelo, and Doboy Sounds; and Altamaha, Savannah, Brunswick, Satilla, Cumberland, St. Mary's, Nassau, and St. John's Rivers. The biotic resources of this section are keyed geographically using east-west UTM grid swaths.

## Aquatic Resources

These estuaries are extremely productive and contain high-energy and high-nutrient inputs. Consequently, the estuaries support a diverse and abundant aquatic population and are critical spawning and nursery areas for numerous shellfish and finfish species.

a. Widespread species. Oysters and clams are permanent residents of these estuaries. Species of commercial and recreational importance include brown and white shrimp, blue crab, menhaden, spotted seatrout, weakfish, spot, Atlantic croaker, southern, northern, and gulf kingfish, red and black drum, bluefish, summer and southern flounder, and sheepshead. Adults may be found either in the rivers and sounds or in the coastal waters.

Within the Sea Islands, shrimp and blue crab comprise the majority of the total commercial fishery. Shrimp is the major fishery in terms of volume and commercial value in South Carolina and Georgia. White shrimp comprises approximately 70 percent of the fishery and brown shrimp comprises about 30 percent; pink shrimp contributes a negligible portion to the total catch. Shrimp is harvested from May to December with mature white shrimp comprising most of the catch in May and June, young brown shrimp comprising most of the catch in June through August, and young white shrimp comprising most of the catch from August through December. Adult brown shrimp also is caught offshore June through September.

Several anadromous species, including the Atlantic sturgeon, American and hickory shad, blueback herring, alewife, and striped bass, migrate through this section during spring to spawn. The alewife, however, occurs only in the northern portion of this section. Other species occurring in the Sea Islands section include freshwater species, such as black crappie, channel and white catfish, redbreast sunfish, warmouth, bluegill, and largemouth bass, and oceanic species, such as black sea bass, cobia, Spanish mackerel, tarpon, and pompano. Mullet, which economically is one of the largest volume yield finfish in South Carolina, cannot be commercially fished in Georgia waters.

Threatened and endangered aquatic organisms found along the Sea Islands coast include one fish, five sea turtles, and seven marine mammals. The short-nose sturgeon migrates up many of the coastal rivers, and the loggerhead turtle nests along the Sea Islands ocean beaches. The Florida manatee rarely inhabits the rivers, bays, and coastal waters of the Georgia and South Carolina Sea Islands during the summer. This mammal is more common in Florida waters, particularly the St. John's River, which has been designated as a critical habitat for the manatee.

b. Geographic inventory. Lake Moultrie and Lake Marion (grid references NG88 and NH60 and vicinity) are famous for their landlocked striped bass, largemouth bass, and black crappie. These lakes are rated among the top ten freshwater fishing spots in the world. The nearby hatcheries rear striped bass, white perch, and white bass, which are stocked in these lakes.

The most significant nesting area for loggerhead turtles in this section extends from North Inlet to Bull Island (grid reference PG78 to PG23). Mating

pairs migrate inshore in March and April, and nesting occurs from mid-May to mid-August.

Winyah Bay (grid reference PG68) and the Black, Pee Dee, and Waccamaw Rivers which flow into the bay are major migration routes for several anadromous species. As a result, a large commercial and sport fishery has developed for American shad, hickory shad, blueback herring, alewife, striped bass, and Atlantic sturgeon. The season for sturgeon occurs offshore during March and April and March through October in the bays and rivers. Winyah Bay (grid reference PG68) may provide an overwintering area for the endangered shortnose sturgeon while the Pee Dee-Waccamaw Rivers (grid reference PG69) may be its spawning ground.

The Santee estuary (grid reference PG66) contains the major hard clam bed within the Sea Islands section. The Santee River is a migratory route for the endangered shortnose sturgeon and may be a spawning ground for this species. The river is also a major recreational and commercial fishing area for shad, herring, and striped bass.

Although shrimp is harvested along the entire Sea Islands coast, one of the most productive areas is the nearshore section from Bull's Bay to Tybee Island (grid reference PG34 to NF13).

The Cooper (grid reference PG02) and Edisto (grid reference NG70) Rivers are major recreational and commercial fishing grounds for shad, herring, and striped bass. The South Edisto River (grid reference NF69) is a migratory route for the endangered shortnose sturgeon. The inshore areas, including St. Helena (grid reference NF59), Port Royal (grid reference NF37), and Calibogue (grid reference NF15) Sounds, are some of the most productive harvest areas for shrimp along the Sea Islands coast.

In Georgia waters, striped bass distribution is spotty; this species is confined to major rivers and adjacent estuaries and is not usually caught off the ocean beaches. Presently, a striped bass management program is underway to augment existing populations in the Savannah (grid reference NF04), Ogeechee (grid reference MF92), and Altamaha (grid reference ME76) Rivers. The Savannah River is important for providing the striped bass with a spawning habitat, and the Altamaha River is a candidate for designation as a scenic river. In addition to the striped bass migrations, the endangered shortnose sturgeon also migrates up the Savannah, Ogeechee, and Altamaha Rivers.

The St. Mary's River (grid reference MD69) is a migratory route for the endangered shortnose sturgeon.

The St. John's River (grid reference MD66 and upstream) is the most southern river along the Atlantic coast that supports migrating and spawning anadromous species. The Federally endangered shortnose sturgeon and the Atlantic sturgeon, which is designated as threatened in Florida, rarely occur in this river. The St. John's River is unusual because many oceanic fish are found in its upper reaches. Several drum species, as well as sheepshead, southern flounder, tarpon, and ladyfish, have been found 121 kilometers (75 miles) upstream near Palatka, Florida, in tidal freshwater. The reason for this distribution appears to be the numerous salt springs that drain into the river. The St. John's River is designated by Florida as a critical habitat for the Florida manatee.

### Terrestrial Resources

More than two-thirds of the coastal portion of the Sea Islands section is forested. This section contains unique elliptical depressions (Carolina Bays) and their associated plant communities of cypress, tupelo, red maple, redbay, and sweetbay. In many areas of this section, forests have reverted to savannahs due to periodic fires. The upland communities of this section consist largely of southern pines. Marshes are abundant on the Sea Islands and wooded swamps are common inland. This area contains some of the most extensive well-developed salt marshes in the United States. The islands are characterized by sand dunes and forest and shrub communities and are separated from the mainland by tidal bays, channels, and lagoons fringed by marshes and mudflats.

a. Widespread species. The large diversity of habitats gives rise to a variety of wildlife composed principally of species which are common to the South Atlantic Zone. Transient and wintering waterfowl and waterbirds concentrate in the waters; herons and egrets breed in swamps; and shorebirds and marsh birds nest on beaches and in marshes.

b. Geographic inventory. A number of unique and significant vegetative features, including unusually large specimens, virgin stands, or rare plants, occur in the Sea Islands section. These features are delineated on the accompanying inventory maps by a descriptor (Tree 307) symbol, and they include the following:

<u>Grid Reference</u>	<u>Feature</u>
PG18	Pecan (large specimen)
PG47	Washington oak (memorial to George Washington)
PG46	Southern bayberry (national champion)
PG16	Spruce pine (large specimen)
PG13	Muster oak (assembling place for Revolutionary militia)
PG12	Sea oats stand (rare plants)
NG96	Red mulberry (national champion); Chinese tallowtree (large specimen)
NG58	Black gum (large specimen)
NG66	American beech (large specimen)
NG84	Middleton oak (oldest tree in South Carolina, estimated at 900 years)
NG65	Waterlocust and eastern hophornbeam (large specimens)

<u>Grid Reference</u>	<u>Feature</u>
NG15	Slash pine (large specimen)
NG94	"The Oaks" (an avenue of oak trees dating back to 1600's)
NG93	Ginko (large specimen); hangman's oak (old tree of historical significance)
NG62	Oak Avenue of Dixie Plantation (aesthetically attractive)
NG81	Angel oak (500 years old)
NF69	Cabbage palmetto (large specimen)
NF28	Live oak (national co-champion)
NF26	Loblolly-bay and redbay (large specimens)
NF17	Southern redcedar (large specimen)
NG67	Swamp cyrilla (national champion).

Santee National Wildlife Refuge (grid references NH60 and NG88) is the southernmost refuge in the South Atlantic Zone where Canada geese spend the winter in large numbers, their populations often reaching 20,000 birds. Species which inhabit the refuge include numerous furbearers, such as bobcat, fox, mink, muskrat, deer, and raccoon, and threatened or endangered species, such as alligator, red-cockaded woodpecker, peregrine falcon, and occasionally bald eagle. Approximately one dozen species of wintering ducks are found here, with total populations as high as 150,000 individuals.

Four Holes Swamp Wilderness Area (grid reference NG58) contains the largest remaining virgin stand of tupelo and cypress trees in the world. Many of these trees attain heights of more than 30 meters (100 feet). This area is a breeding ground and excellent habitat for otter, mink, deer, black bear, bobcat, and other furbearers. In addition, a variety of herons, songbirds, Mississippi and swallow-tailed kites, and alligators reside here.

The Francis Marion National Forest (grid reference PG18 to PG24) covers 97,000 hectares (240,000 acres) and contains diverse habitats for landbird species. The rare and endangered Bachman's warbler has nested here in the past.

Pumpkinseed Island (grid reference PG56) is a major wading bird nesting site where several thousand herons and egrets breed during the warmer months. The nesting estimates for the more common species are white ibis (10,000 to 15,000 pairs), glossy ibis (200 to 2,000 pairs), Louisiana heron (2,000 to 2,500 pairs), snowy egret (250 to 800 pairs), cattle egret (300 to 1,000 pairs), and great egret (100 to 1,000 pairs).

A primary area for wildlife on the Atlantic coast is the 24,300 hectares (60,000 acres) of barrier islands, forests, salt marshes, creeks, waterways, and beaches composing the Cape Romain National Wildlife Refuge (grid reference PG56 to PG23). Most of the Atlantic coast population of American oystercatchers and endangered brown pelicans winters at Cape Romain, and as many as nine species of herons and egrets also winter here. Bull Island, in the refuge, is renowned for its abundant and diverse bird life which includes many songbirds, marsh birds, shorebirds, wading birds, and waterfowl. Songbird migrations in spring are often spectacular because of their size and variety. Alligator, otter, and whitetail deer also inhabit this refuge.

An important tern and skimmer nesting area is on Bird Island (grid reference PG34). About 2,000 black skimmers and nearly 8,000 breeding terns of four species nest here, with the royal tern representing the largest population.

One of the largest white ibis rookeries in South Carolina is at grid reference PG24. This rookery is also the last known nesting area in North America for the endangered Bachman's warbler, which prefers river swamp forests. In 1929, two confirmed sightings were made in this area of the endangered, and now possibly extinct, ivory-billed woodpecker. Other species of concern nesting here are Swainson's warblers, osprey, and wood storks.

The largest wading bird rookery on the Atlantic coast is Drum Island (grid reference PG03), where 25,000 to 30,000 pairs of herons and egrets nest annually. The most common species and nesting estimates are white ibis (10,000 to 11,000 pairs), snowy egret (5,000 pairs), glossy ibis (400 to 500 pairs), yellow-crowned night heron (2,300 pairs), and little blue heron (1,000 pairs). At this rookery, approximately 25,000 young wading birds are produced yearly.

Magnolia gardens near Charleston, South Carolina (grid reference NG83), provide an excellent habitat for different types of waterbirds, waterfowl, and songbirds. Anhingas, herons, egrets, ibises, ospreys, ducks, warblers, and occasionally bald eagles are found here.

A major colonial shorebird nesting site is at Bird Bank, South Carolina (grid reference NG91), where over 18,000 pairs have been counted in one season. Major breeding species and nesting pair estimates are royal tern (3,400 to 10,400 pairs), laughing gull (160 to 3,000 pairs), least tern (500 pairs), black skimmer (468 pairs), and gull-billed tern (64 to 200 pairs).

Another area containing large numbers of nesting shorebirds is Deveaux Bank (grid reference NG70) where a total of nearly 24,000 pairs were counted on two occasions in 1 year. This count included royal tern (18,400 pairs), laughing gull (7,300 pairs), brown pelican (535 pairs), black skimmer (700 pairs), and sandwich tern (300 pairs). Nearby White Island (grid reference NG90) serves as a nesting site for more than 3,000 endangered brown pelicans.

A portion of the Ashepoo-Combahee-Edisto River Basin (grid reference NG60) is an exceptional area containing undisturbed bottom land, hardwood, and brackish and freshwater impoundments. Six active bald eagle nests, the largest concentration of bald eagles in South Carolina, are found here. This area also contains large populations of many other species, including waterfowl in winter,

red-cockaded woodpeckers, American alligators, wood storks, Mississippi kites, ospreys, Swainson's warblers, black bears, river otters, and bobcats.

The area near grid reference MF99 is a complex of fire-maintained savannahs which support extremely diverse populations of amphibians and reptiles. More than 100 species have been recorded here, and the area is nationally known among herpetologists for its extraordinary species diversity.

The Savannah National Wildlife Refuge (grid reference MF87 to MF95) is one of the nation's oldest refuges; it harbors an abundance of diverse wildlife. Large numbers of wood ducks, hawks, wading birds, marsh birds, alligators, reptiles, and amphibians are found here. Wood ducks probably nest in greater numbers here than at any other refuge, and the wood duck population often reaches 20,000 individuals.

Nearly 7,000 wading birds nest at Satilla River (grid reference ME52), including white ibis (3,500 pairs), Louisiana heron (700 to 2,000 pairs), great egret (600 to 1,000 pairs), and snowy egret (600 to 1,000 pairs).

#### 6.6 EAST FLORIDA (GRID REFERENCE MD66 TO NU88)

The East Florida section of the South Atlantic Zone extends from the St. John's River to Fort Lauderdale on the south, a distance of some 483 kilometers (300 miles). This coastline differs markedly from the Sea Islands section because the East Florida coast is characterized by long barrier islands which protect narrow, shallow, coastal lagoons. These lagoons, which include the Tolomato, Matanzas, and Halifax Rivers, Mosquito Lagoon, Banana, Indian, and St. Lucie Rivers, Hobe Sound, and Lake Worth, are connected to the sea through inlets. Since they receive freshwater from only a few small rivers and streams, these lagoons normally have high salinities except during the rainy season, when they receive large quantities of freshwater. Tidal marshes and seagrass beds characteristically rim the lagoonal rivers in the north, but in the southern half of this section, mangrove swamps become prominent. Many of the coastal areas have been set aside by Florida as aquatic preserves.

The Continental Shelf on the East Florida coast becomes increasingly narrow toward the south; at Fort Pierce, it is 32 kilometers (20 miles) wide and at Fort Lauderdale, it is 6 kilometers (4 miles) wide. The warm tropical currents of the Gulf Stream also are close to the coast in this area. The sediments of the shelf are basically sandy here, but hard bottom areas and coral reefs are sometimes present. In the northern portion of this section, these reefs mostly occur beyond the three-mile limit; however, in the area extending southward from Cocoa Beach (grid reference NB33), the reef lines are in the coastal zone.

The biotic resources for this section are keyed geographically using east-west UTM grid swaths.

##### Aquatic Resources

a. Widespread species. These features provide for a variety of aquatic habitats and a high diversity of aquatic organisms, which includes more than 500 species of shellfish and finfish. Hard clam, blue crab, and oyster are found in the lagoonal estuaries and are of commercial and recreational importance. Many

estuarine-dependent species common to the Middle and South Atlantic Zones are also found in the East Florida section, including white, brown, and pink shrimp, summer and southern flounder, bluefish, Atlantic croaker, spot, spotted seatrout, weakfish, red and black drum, southern and gulf kingfish, striped and white mullet, and menhaden. These species mostly spawn in the ocean, but species such as the spotted seatrout and weakfish spawn in the brackish portion of the estuaries. Juveniles use lagoons as nursery grounds during the summer.

White and brown shrimp are the most valuable commercial shellfish in this section, whereas king and Spanish mackerel and snappers are the most valuable finfish. Menhaden, however, is the major commercial species harvested by volume.

Seagrass beds in this section, particularly in the south, are composed of turtle grass (Thalassia testudinum) and manatee grass (Syringodium filiforme). Many tropical migrants, including tarpon, pompano, snook, ladyfish, pigfish, and grunt, use the lagoons as nursery areas. Adults of temperate and tropical species are found along the entire coast.

Several tropical oceanic species, including king and Spanish mackerel, grouper, snapper, little tunny, and sailfish, also are of commercial and recreational importance to the East Florida fishery. North of Palm Beach (grid reference NV95), most fishing for the Spanish mackerel is conducted offshore from March to October, while to the south, fishing for both species occurs during October through April.

The grouper family is represented by numerous species, including the gag, the speckled hind, and the Nassau, black, red, and warsaw grouper, and the jewfish, of which the latter three are the most important inshore species. These groupers are fished throughout the year. The snapper family is represented by the lane, silk, mutton, gray, vermilion, red, and yellowtail snappers. The latter four tend to be the most common inshore species south of Palm Beach (grid reference NV94). Although these species are fished all year, the best fishing generally occurs in the spring and fall. The sailfish is concentrated in the East Florida section during November through February.

Five threatened and endangered sea turtles and seven marine mammals are present in East Florida coastal waters, several of which are of particular importance. These species include the loggerhead turtle, green sea turtle, leatherback turtle, and the Florida manatee.

The loggerhead turtle nests throughout the East Florida coast. It is estimated that 19,895 nests are dug in Florida each year by approximately 14,210 females which comprise 90 percent of the total U.S. population. For the Atlantic coast, the green sea turtle nests only in Florida, where its population is estimated at about 50 mature females. Leatherback turtle nests along the Atlantic coast are rare, but some 10 to 12 nests occur annually, and all are located in Florida.

A major portion of the Florida manatee population in the United States (750 to 850 individuals) is in East Florida where some 400 to 500 individuals occur. The center for the manatee population in East Florida is in the St. John's River and along the coastal zone between New Smyrna Beach and the St. Lucie River (grid reference NC01 to NA80). Locations where Florida has set aside numerous habitats

which are critical to the continued existence of the manatee are shown on the East Florida inventory maps. Several of these areas are legal sanctuaries in which motorboat speeds and operations are limited between November 15 and March 31.

b. Geographic inventory. Leatherback turtles rarely nest along the Atlantic coast; however, nesting is reported to occur as far north as Flagler Beach (grid reference MC86) and as far south as Miami (grid reference NU85).

The wide Continental Shelf and well-developed estuarine system, characterizing the coastline of the northern portion of the East Florida section, from the St. John's River (grid reference MD66) to St. Lucie Inlet (grid reference NA80), contain a major commercial concentration of estuarine-dependent temperate species including drum, flounder, shrimp, and menhaden.

Indian River, the largest estuarine system in East Florida (grid reference NB18 to NA80), contains major populations of hard clam, blue crab, oyster, and mullet. The spotted seatrout is the most sought after recreational species in the river and is the only game fish that spends its entire life cycle within the estuary.

The area extending from Cape Canaveral (grid reference NB44) to Palm Beach (grid reference NV94) and, in particular, Hutchinson Island and Jupiter Island (grid reference NA73 to NV89), on the seaward side of Indian River, is the major sea turtle nesting area along the Atlantic coast. Species which nest here include the threatened loggerhead turtle and the endangered green sea turtle. A single nesting of the endangered hawksbill was reported in 1974 on Jupiter Island.

Bluefish concentrates from Sebastian Inlet (grid reference NA58) to Lake Worth Inlet (grid reference NV93) during November through April; however, this species migrates northward during the summer. The sailfish, one of the most sought after recreational species, is concentrated from Fort Pierce (grid reference NA63) to Jupiter Inlet (grid reference NV98) in 18 to 76 meters (60 to 250 feet) of water during November to February.

The leatherback turtle nests only rarely along the Atlantic coast, mainly in Martin and Palm Beach Counties (grid reference NA71 to NV91).

In the southern portion of the East Florida section, extending southward from St. Lucie Inlet (grid reference NA80), the high-relief coral outcrops are well-developed inshore. As a result, many of the species which prefer this habitat, including groupers, snappers, and king and Spanish mackerel, are in abundance in these areas. The spiny lobster also becomes more abundant in this stretch.

Gray, vermilion, red, and yellowtail snappers tend to be the most common inshore species south of Palm Beach (grid reference NV94).

### Terrestrial Resources

Numerous salt marshes border the lagoons and rivers in the northern portion of East Florida although mangroves grow in scattered clumps around Mosquito

Lagoon (grid reference NB37). To the south, the mangroves gradually become more abundant and replace the northern section's salt marshes. The mainland of East Florida contains many different habitat types; the more important habitats for wildlife include pinelands, scrublands, and swamps. Pinelands consist of open forests containing longleaf and slash pines with shrub thickets. Scrublands support scrub oaks and thickets of saw palmetto. Swamps contain cypress and hardwoods.

a. Widespread species. Large numbers of animals breed in Florida's marshes and swamps and their ecotones. Birds are plentiful and include many species of heron, egret, ibis, and other waterbirds common to the South Atlantic Zone. Shorebirds commonly breed in this section; however, major nesting sites for shorebirds or wading birds, and the species diversity, are not as great as in other sections of the South Atlantic Zone. Although the total number of breeding species is relatively small, winter concentrations are often extremely large. In the winter, the lesser scaup and the American coot are the most abundant waterfowl.

b. Geographic inventory. One of the least disturbed swamp areas in east-central Florida, near grid reference NC00 to NB19, includes a wood stork rookery, containing 100 to 200 nests. This swamp also serves as a nesting area for other wading birds and ospreys.

The area adjacent to the Cape Canaveral Peninsula and Merritt Island National Wildlife Refuge (grid reference NB28 to NB34) contains some of the most impressive bird concentrations in the South Atlantic Zone. Among species of special status which have been sighted here are the bald eagle, peregrine falcon, brown pelican (with up to 400 nests), dusky seaside sparrow, and American alligator. The rare wood stork also breeds here and occupies about 300 nests. This area contains the largest number of wading bird species on the East Coast. Eleven species of herons, egrets, and ibises nest yearly. Large numbers of songbirds and raptors migrate through this area, often stopping over for short periods of time. Winter concentrations of waterfowl may attain populations of more than 70,000 birds and may include 23 different species.

Saint Johns National Wildlife Refuge (grid references NB15 and NB14) was established to provide a breeding habitat for the endangered dusky seaside sparrow. All of the known males (less than 30) of this endangered species congregate here in the spring. The population of females may be even less.

The area between grid references NB03 and NB04, containing extensive marshes, is considered as a potential habitat for the dusky seaside sparrow. Important species common to this area include the bald eagle, American alligator, eastern indigo snake, Florida sandhill crane, osprey, and wood stork.

Pelican Island National Wildlife Refuge (grid reference NA57) is historically important, since it was the first National Wildlife Refuge in the United States. This site, formerly was the only known nesting area for the brown pelican, but now it also is important to a number of other species including heron, egret, ibis, anhinga, and double-crested cormorant.

## 6.7 BISCAYNE BAY (GRID REFERENCE NU88 TO NT68)

The Biscayne Bay section, extending from Fort Lauderdale (grid reference NU88) to the southern end of the Atlantic Coastal Zone at Garden Cove (grid reference NT68), represents a transition between the sandy barrier islands to the north and the low rocky, remnant coral reef islands to the south. From Fort Lauderdale (grid reference NU88) to Soldier Key (grid reference NU83), the coast is characterized by rocky reefs with encrusting corals and sponges; south of Soldier Key, living, reef-building corals predominate. These reefs are distributed in three distinct chains; the first or inside reef is located in 3 to 6 meters (10 to 20 feet) of water. The second or outer reef runs along the 21-meter (70 foot) contour, and third or deep reef runs along the 37-meter (120-foot) contour. Due to map scale limitations, only the second and third reefs are shown on the inventory maps.

Other distinctive features within the Biscayne Bay section include the extremely narrow Continental Shelf ranging from 5 kilometers (3 miles) off Miami Beach to 16 kilometers (10 miles) off the Florida Keys and the proximity of the Gulf Stream to land--along the 37-meter (120-foot) contour.

The biotic resources of this section are keyed geographically using east-west UTM grid swaths.

### Aquatic Resources

a. Widespread species. Two species which are both unique and of commercial importance to the Biscayne Bay section are the spiny lobster and stone crab. The spiny lobster is the most valuable fishery in this region.

Most of the major commercial and recreational fish species are associated with the nearshore reef system and are evenly distributed throughout this section. The bays, ocean beach, and first reef provide a habitat for spotted seatrout, southern and gulf kingfish, pompano, tarpon, snook, Spanish mackerel, ladyfish and juvenile groupers, snappers, and jacks. The second reef provides a habitat for adult groupers and snappers. These species also are found seaward of the second reef out to the third reef, along with adult jack, king mackerel, and sailfish. Swordfish occasionally occurs nearshore, but it is more common beyond the 183-meter (600-foot) contour over high-relief rock and coral environments. Although these species are fished all year, the best seasons are generally from mid-fall through spring, since many species migrate to deeper or more northern waters during the summer months.

b. Geographic inventory. Major aquatic parks in this section include Biscayne Bay Aquatic Preserve (grid reference NU86 to NT69), Biscayne National Monument (grid reference NU62 to NU80), and John Pennekamp Coral Reef State Park (grid reference NU70 to NT56).

Several aquatic species of special status inhabit the coastal portion of Biscayne Bay, although they are only rarely observed; they include seven species of marine mammals and five species of sea turtles. The Florida manatee occurs throughout the section and is particularly prominent in the northern portion of Biscayne Bay (grid reference NU86 to NU73), which is a designated critical habitat. Loggerhead, green sea, and leatherback turtle nesting areas have been

reported on the beaches near Fort Lauderdale and Hollywood (grid references NU88 and NU87).

Along the coast around southern Biscayne Bay and Card and Barnes Sounds (grid reference NU62 to NT58), unique mangrove swamps, composed of red, black, and white mangroves, and numerous forms of algae provide a high input of nutrients and energy into the surrounding aquatic ecosystem. The mangrove swamps also serve as nursery areas for several major recreational and commercial aquatic species in the area, including menhaden, mullet, spotted seatrout, red drum, snapper, pompano, tarpon, snook, and shrimp.

### Terrestrial Resources

The Biscayne Bay section is considered to be a subtropical region. The inland portions of this section are dominated by pinelands, composed principally of slash pine and an understory containing numerous tropical plants. Coastal marshes are interspersed with mangrove swamps throughout this section, and on the northern keys, a variety of mangroves and tropical hardwood trees are found.

a. Widespread species. Some 93 species of birds occur regularly on the keys and 12 species nest here. The most common species include the following: brown pelican, double-crested cormorant, magnificent frigate-bird, bald eagle, osprey, great blue (white) heron, and red egret. Important mammals which occur on the islands include bobcat, raccoon, and opossum.

b. Geographical inventory. Large breeding colonies of wading birds or shorebirds are not known to inhabit this section, but the area centered around metropolitan Miami (grid reference NU76 to NU73) is unique for its exotic bird species, many of which have been introduced from tropical Latin American and Caribbean regions. Some of these species have established breeding populations in this locality, and may expand their range northward when they become part of the regional fauna.

The major portion of the 38,900 hectares (96,000 acres) which composes Biscayne National Monument (grid reference NU62 to NU80) consists of a marine and reef community, and 25 islands (keys) lie within its borders. Since this park is in proximity to temperate and tropic zones, it contains important habitats for wildlife for both zones.

The critical habitat for the American crocodile, designated as endangered by the FWS, includes the area defined by grid reference NU61 to NT67.

On north Key Largo two sites (grid references NT79 and NT68) are especially important for a number of species. The upland portions of these sites consist of tropical hardwood hammocks, a vegetative type which is nearly extinct in Florida. A total of about ten species of special status, or concern, are either permanent or seasonal residents at these sites. The woodlands at the sites are the sole habitat suitable for the Key Largo wood rat and the Key Largo cotton mouse. These sites also are the only known nesting locations of American crocodile outside of Everglades National Park; in 1978, five nests were located on north Key Largo.

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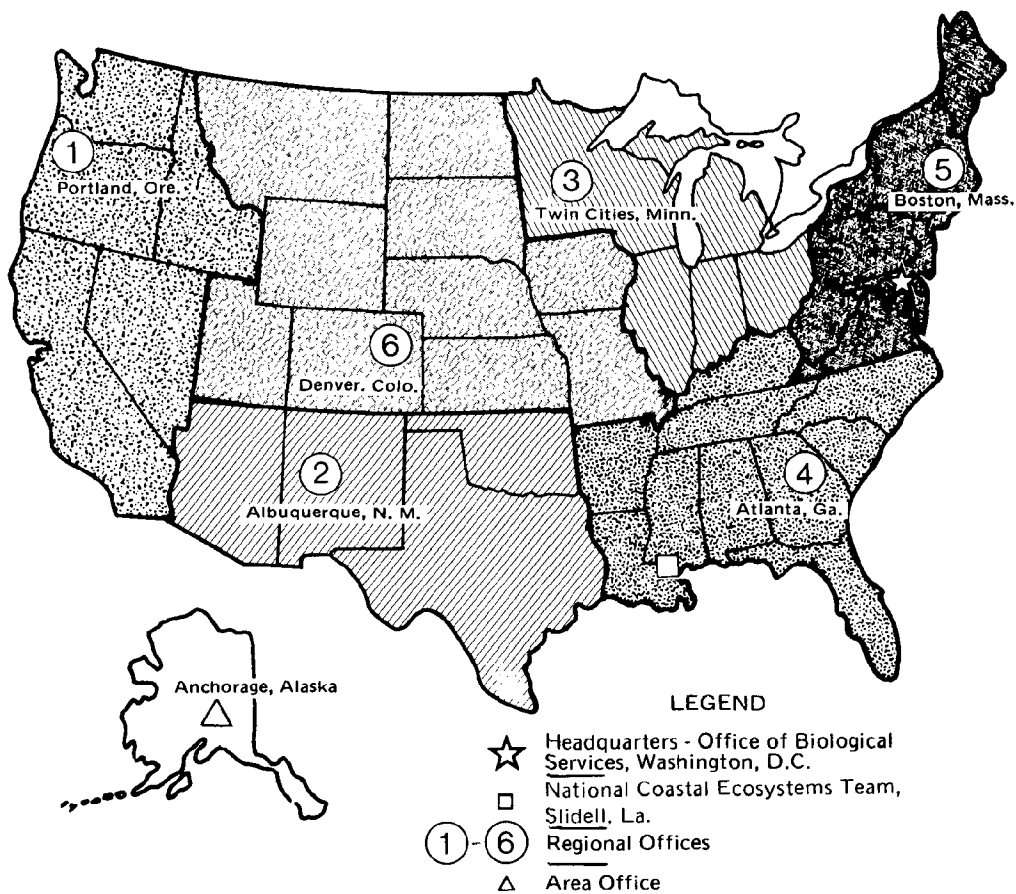
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16. Abstract (Limit: 200 words)  This study provides an inventory of important ecological resources along the Atlantic Coastal Zone, an area of some 196,840 square kilometers (76,000 square miles). This inventory is intended to provide government and industry decision-makers with valuable ecological information which will assist in the regional siting of oil- and gas-processing and manufacturing facilities and their respective transportation systems. The preparation of this ecological inventory involved four major tasks: the collection, review, and analysis of available data on coastal fish and wildlife species and their habitats and special land-use areas; the synthesis and compilation of these data into a format which is compatible with the requirements of 1:250,000-scale mapping; the preparation of a series of 31 resource inventory graphics for the Atlantic Coastal Zone; and the preparation of a report narrative keyed to the inventory graphics. The report is organized in accordance with the hierarchical classification scheme for coastal ecosystems devised by Terrell (1979). Ecological resources are summarized by their appropriate geographic zone, and descriptions and locations of species with special status and aquatic and terrestrial species of high commercial, recreational, and aesthetic value are included. The designation of more than 550 special land-use areas along the Atlantic Coast also is provided.				
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## DEPARTMENT OF THE INTERIOR U.S. FISH AND WILDLIFE SERVICE



As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

